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PATENT

Attorney Docket No. 002010-682

BE IT KNOWN, that we, Andrei W. KONRADI, Michael A. PLEISS, Eugene D. THORSETT, Susan ASHWELL, Gregory S. WELMAKER, Anthony KREFT, Dimitrios SARANTAKIS, Darren B. DRESSEN, Francine S. GRANT, Christopher SEMKO and YING-ZI XU have invented new and useful improvements in:

**PHENYLALANINE DERIVATIVES AS ALPHA 4
INTEGRIN INHIBITORS**

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Patent Application Serial No. 60/220,134, filed July 21, 2000, the disclosures of which are incorporated herein by reference in their entirety.

PHENYLALANINE DERIVATIVES AS ALPHA 4 INTEGRIN INHIBITORS

This invention relates to a series of phenylalanine derivatives, to compositions containing them, to processes for their preparation, and to their use in medicine.

Over the last few years it has become increasingly clear that the physical interaction of inflammatory leukocytes with each other and other cells of the body plays an important role in regulating immune and inflammatory responses [Springer, T A. Nature, 346 425, (1990); Springer, T. A. Cell 76, 301, (1994)]. Many of these interactions are mediated by specific cell surface molecules collectively referred to as cell adhesion molecules.

The adhesion molecules have been sub-divided into different groups on the basis of their structure. One family of adhesion molecules which is believed to play a particularly important role in regulating immune and inflammatory responses is the integrin family. This family of cell surface glycoproteins has a typical non-covalently linked heterodimer structure. At least 14 different integrin α chains and 8 different integrin β chains have been identified [Sonnenberg, A Current Topics in Microbiology and Immunology, 18, 7, (1993)]. The members of the family are typically named according to their heterodimer composition although trivial nomenclature is widespread in this field. Thus the integrin termed $\alpha 4 \beta 7$ consists of the integrin $\alpha 4$ chain associated with the integrin $\beta 1$ chain, but is also widely referred to as Very Late Antigen 4 or VLA4. Not all of the potential pairings of integrin α and β chains have yet been observed in nature and the integrin family has been subdivided into a number of subgroups based on the pairings that have been recognized [Sonnenberg, A., *ibid.*].

The importance of cell adhesion molecules in human leukocyte function has been further highlighted by a genetic deficiency disease called Leukocyte Adhesion Deficiency (LAD) in which one of the families of leukocyte integrins is

not expressed [Marlin, S. D. *et al.*, Exp. Med. 164, 855 (1986)]. Patients with this disease have a reduced ability to recruit leukocytes to inflammatory sites and suffer recurrent infections which in extreme cases may be fatal.

The potential to modify adhesion molecule function in such a way as to
5 beneficially modulate immune and inflammatory responses has been extensively investigated in animal models using specific monoclonal antibodies that block various functions of these molecules [e.g. Issekutz, T. B. J. Immunol. 3394, (1992); Li, Z. *et al.*, Am. J. Physiol. 263, L723, (1992); Binns, R. M. *et al.*, J. Immunol. 157, 4094, (1996)]. A number of monoclonal antibodies which block
10 adhesion molecule function are currently being investigated for their therapeutic potential in human disease.

One particular integrin subgroup of interest involves the $\alpha 4$ chain which can pair with two different β chains $\beta 1$ and $\beta 7$ [Sonnenberg, A. *ibid*]. The $\alpha 4\beta 1$ pairing occurs on many circulating leukocytes (for example, lymphocytes,
15 monocytes and eosinophils) although it is absent or only present at low levels on circulating neutrophils. $\alpha 4\beta 1$ binds to an adhesion molecule (Vascular Cell Adhesion Molecule-1 also known as VCAM-1) frequently up-regulated on endothelial cells at sites of inflammation [Osborne, L. Cell, 62, 3, (1990)]. The molecule has also been shown to bind to at least three sites in the matrix molecule
20 fibronectin [Humphries, M. J. , *et al.*, Ciba Foundation Symposium, 189, 177, (1995)]. Based on data obtained with monoclonal antibodies in animal models it is believed that the interaction between $\alpha 4\beta 1$ and ligands on other cells and the extracellular matrix plays an important role in leukocyte migration and activation [Yednock, T. A , *et al.*, Nature, 356, 63, (1992); Podolsky, D.K., *et al.*, J. Clin.
25 Invest. 92, 373, (1993); Abraham, W. M., *et al.*, J. Clin. Invest. 93, 776, (1994)].

The integrin generated by the pairing of $\alpha 4$ and $\beta 7$ has been termed LPAM-1 [Holzmann, B and Weissman, I. EMBO J. 8, 1735, (1989)] and like

$\alpha 4\beta 1$, binds to VCAM-1 and fibronectin. In addition, $\alpha 4\beta 7$ binds to an adhesion molecule believed to be involved in the homing of leukocytes to mucosal tissue termed MAdCAM-1 [Berlin, C. et al., Cell, 74, 185, (1993)]. The interaction between $\alpha 4\beta 7$ and MAdCAM-1 may also be important at sites of inflammation outside of mucosal tissue [Yang, X-D. et al., PNAS, 91, 12604 (1994)].

Regions of the peptide sequence recognized by $\alpha 4\beta 1$ and $\alpha 4\beta 7$ when they bind to their ligands have been identified. $\alpha 4\beta 1$ seems to recognize LDV, IDA or REDV peptide sequences in fibronectin and a QIDSP sequence in VCAM-1 [Humphries, M. J. et al., *ibid*] while $\alpha 4\beta 7$ recognizes a LDT sequence in MAdCAM-1 [Briskin, M. J. et al., J. Immunol. 156, 719, (1996)]. There have been several reports of inhibitors of these interactions being designed from modifications of these short peptide sequences [Cardarelli, P. M. et al., J. Biol. Chem. 269, 18668, (1994); Shroff, H. N. Bioorganic. Med. Chem. Lett. 6, 2495, (1996); Vanderslice, P. J. Immunol. 158, 1710, (1997)]. It has also been reported that a short peptide sequence derived from the $\alpha 4\beta 1$ binding site in fibronectin can inhibit a contact hypersensitivity reaction in a trinitrochlorobenzene sensitized mouse [Ferguson, T. A. et al., PNAS 88, 8072, (1991)].

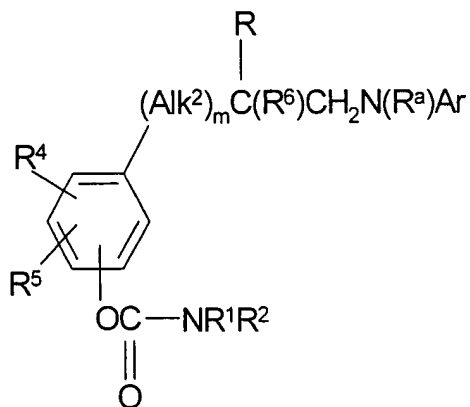
Since the alpha 4 subgroup of integrins are predominantly expressed on leukocytes their inhibition can be expected to be beneficial in a number of immune or inflammatory disease states. However, because of the ubiquitous distribution and wide range of functions performed by other members of the integrin family it is very important to be able to identify selective inhibitors of the alpha 4 subgroup.

SUMMARY OF THE INVENTION

This invention is directed to a group of compounds which are potent and selective inhibitors of $\alpha 4$ integrins. Members of the group are able to inhibit $\alpha 4$ integrins such as $\alpha 4\beta 1$ and/or $\alpha 4\beta 7$ at concentrations at which they generally have no or minimal inhibitory action on α integrins of other subgroups. The

compounds are thus of use in medicine, for example in the prophylaxis and treatment of immune or inflammatory disorders as described hereinafter.

Thus according to one aspect of the invention we provide a compound of formula (I):



wherein

R¹ and R² are independently selected from the group consisting of hydrogen, alkyl, substituted alkyl, alkenyl, substituted alkenyl, cycloalkyl, substituted cycloalkyl, or R¹ and R², together with the nitrogen atom to which they are attached, are joined to form an optionally substituted heterocyclic ring provided that said substituted alkyl, substituted alkenyl and substituted cycloalkyl do not carry an aryl, substituted aryl, heteroaryl or substituted heteroaryl group;

R⁴ and R⁵ are independently selected from the group consisting of -L²(Alk³)_tL³(R⁷)_u in which L² and L³ are independently a covalent bond or a linker atom or group, *t* is zero or the integer 1, *u* is an integer 1, 2, or 3, Alk³ is an aliphatic or heteroaliphatic chain and R⁷ is hydrogen or halogen atom or a group selected from alkyl, -OR⁸ [where R⁸ is a hydrogen atom or an optionally substituted alkyl group], -SR⁸, -NR⁸R⁹ [where R⁸ is a hydrogen atom or an optionally substituted alkyl group], -NO₂, -CN, -CO₂R⁸, -SO₃H, -SOR⁸, -SO₂R⁸, -OCO₂R⁸, -CONR⁸R⁹, -CSNR⁸R⁹, -COR⁸, -OCOR⁸, -N(R⁸)COR⁹, -N(R⁸)CSR⁹,

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-SO₂N(R⁸)(R⁹), -N(R⁸)SO₂R⁹, -N(R⁸)CON(R⁹)(R¹⁰), [where R¹⁰ is a hydrogen atom or an optionally substituted alkyl group], -N(R⁸)CSN(R⁹)(R¹⁰) or -N(R⁸)SO₂N(R⁹)(R¹⁰);

Alk² is a straight or branched alkylene chain;

m is zero or an integer 1;

R⁶ is a hydrogen atom or a methyl group;

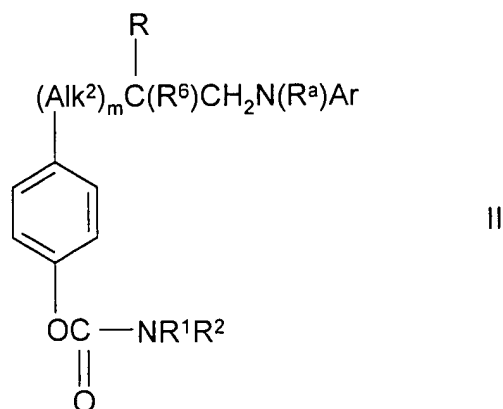
R is a carboxylic acid (-CO₂H) or a derivative thereof;

R^a is a hydrogen or a methyl group;

Ar is an optionally substituted aromatic or heteroaromatic group;

and the salts, solvates, hydrates and N-oxides thereof.

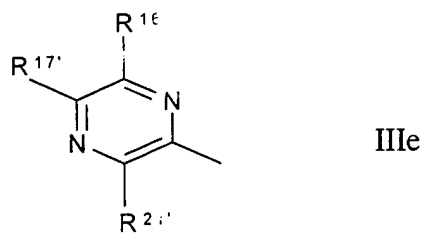
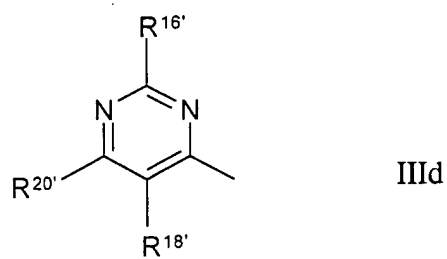
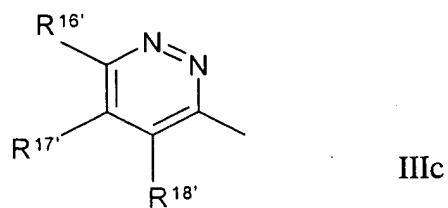
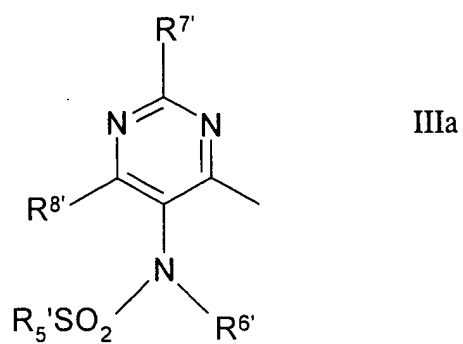
One preferred group of compounds of this invention include compounds of formula (2):

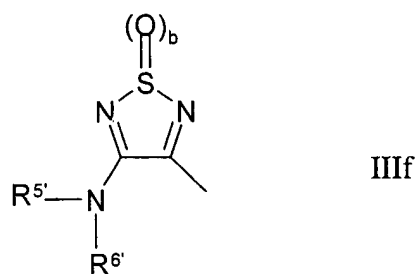


wherein R, R^a, R¹, R², R⁶, Alk², *m* and Ar are as defined above and the salts, solvates, hydrates and N-oxides thereof.

Another class of compounds of this invention is where Ar is selected from the group consisting of moieties of formula IIIa, IIIc, IIId, IIIe or IIIf:

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wherein

10 R^{5'} is selected from the group consisting of alkyl, substituted alkyl, alkenyl, substituted alkenyl, aryl, substituted aryl, cycloalkyl, substituted cycloalkyl, cycloalkenyl, substituted cycloalkenyl, heterocyclic, substituted heterocyclic, heteroaryl and substituted heteroaryl;

15 R^{6'} is selected from the group consisting of hydrogen, alkyl, substituted alkyl, cycloalkyl, substituted cycloalkyl, cycloalkenyl, substituted cycloalkenyl, heterocyclic, substituted heterocyclic, aryl, substituted aryl, heteroaryl, substituted heteroaryl, and -SO₂R^{10'} where R^{10'} is selected from the group consisting of alkyl, substituted alkyl, cycloalkyl, substituted cycloalkyl, cycloalkenyl, substituted cycloalkenyl, heterocyclic, substituted heterocyclic, aryl, substituted aryl,

20 heteroaryl, substituted heteroaryl;

 R^{7'} and R^{8'} are independently selected from the group consisting of hydrogen, alkyl, substituted alkyl, cycloalkyl, substituted cycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclic, substituted heterocyclic and halogen;

25 R^{16'} and R^{17'} are independently selected from the group consisting of hydrogen, alkyl, substituted alkyl, alkoxy, substituted alkoxy, amino, substituted amino, cycloalkyl, substituted cycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclic, substituted heterocyclic and halogen; and

$R^{18'}$ is selected from the group consisting of alkyl, substituted alkyl, alkoxy, substituted alkoxy, amino, substituted amino, cycloalkyl, substituted cycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclic and substituted heterocyclic;

5 $R^{20'}$ is selected from the group consisting of hydrogen, alkyl, substituted alkyl, alkoxy, substituted alkoxy, cycloalkyl, substituted cycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclic, substituted heterocyclic and halogen;

10 $R^{21'}$ is selected from the group consisting of alkyl, substituted alkyl, alkoxy, substituted alkoxy, amino, substituted amino, cycloalkyl, substituted cycloalkyl, aryl, substituted aryl, heterocyclic and substituted heterocyclic;

b is 1 or 2;

and enantiomers, diastereomers and pharmaceutically acceptable salts thereof.

15 It will be appreciated that compounds of formula (I) and (II) may have one or more chiral centres, and exist as enantiomers or diastereomers. The invention is to be understood to extend to all such enantiomers, diastereomers and mixtures thereof, including racemates. Formulae (I) and (II) and the formulae hereinafter are intended to represent all individual isomers and mixtures thereof,
20 unless stated or shown otherwise.

In the compounds of formulae (1) and (2), derivatives of the carboxylic acid group, R, include carboxylic acid esters and amides. Particular esters and amides include $-CO_2Alk^5$ and $-CONR^8R^9$ groups as described herein.

25 Alk^2 in the compounds of the invention may be for example a straight or branched C_{1-3} alkylene chain. Particular examples include $-CH_2-$, $-CH(CH_3)-$ and $-(CH_2)_2-$.

When in the compounds of formula (1), L^2 and/or L^3 is present as a linker atom or group it may be any divalent linking atom or group. Particular

examples include -O- or -S- atoms or -C(O)-, -C(O)O-, -OC(O)-, -C(S)-, -S(O)-, -S(O)₂-, -NR¹¹- [where R¹¹ is a hydrogen atom or an optionally substituted alkyl group], -CON(R¹¹)-, -OC(O)N(R¹¹)-, -CSN(R¹¹)-, -N(R¹¹)CO-, -N(R¹¹)C(O)O-, -N(R¹¹)CS-, -S(O)₂N(R¹¹)-, -N(R¹¹)S(O)₂-, -N(R¹¹)CON(R¹¹)-, -N(R¹¹)CSN(R¹¹)-, or -N(R¹¹)SO₂N(R¹¹)- groups. Where the linker group contains two R¹¹ substituents, these may be the same or different.

When R⁷, R⁸, R⁹, R¹⁰ and/or R¹¹ in the compounds of formula (1) is an alkyl group it may be a straight or branched C₁₋₆ alkyl group, e.g. a C₁₋₃ alkyl group such as a methyl or ethyl group. Optional substituents which may be present on such groups include for example one, two or three substituents which may be the same or different selected from halogen atoms, for example fluorine, chlorine, bromine or iodine atoms, or hydroxy or C₁₋₆ alkoxy e.g. methoxy or ethoxy groups.

When Alk³ is present in the compounds of formula (1) as an aliphatic or heteroaliphatic chain it may be for example any of C¹-C¹⁰ aliphatic or heteroaliphatic chains.

When Alk³ is present in compounds of formula (1) as an optionally substituted aliphatic chain it may be an optionally substituted C₁₋₁₀ aliphatic chain. Particular examples include optionally substituted straight or branched chain C₁₋₆ alkyl, C₂₋₆ alkenyl, or C₂₋₆ alkynyl chains.

Heteroaliphatic chains represented by Alk³ include the aliphatic chains just described but with each chain additionally containing one, two, three or four heteroatoms or heteroatom-containing groups. Particular heteroatoms or groups include atoms or groups L⁴ where L⁴ is as defined above for L¹ when L¹ is a linker atom or group. Each L⁴ atom or group may interrupt the aliphatic chain, or may be positioned at its terminal carbon atom to connect the chain to an adjoining atom or group.

Particular examples of aliphatic chains represented by Alk^1 include optionally substituted $-\text{CH}_2-$, $-\text{CH}_2\text{CH}_2-$, $-\text{CH}(\text{CH}_3)-$, $-\text{C}(\text{CH}_3)_2-$, $-(\text{CH}_2)_2\text{CH}_2-$, $-\text{CH}(\text{CH}_3)\text{CH}_2-$, $-(\text{CH}_2)_3\text{CH}_2-$, $-\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_2-$, $-\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2-$, $-\text{C}(\text{CH}_3)_2\text{CH}_2-$, $-(\text{CH}_2)_4\text{CH}_2-$, $-(\text{CH}_2)_5\text{CH}_2-$, $-\text{CHCH}-$, $-\text{CHCHCH}_2-$, $-\text{CH}_2\text{CHCH}-$, $-\text{CHCHCH}_2\text{CH}_2-$, $-\text{CH}_2\text{CHCHCH}_2-$, $-(\text{CH}_2)_2\text{CHCH}-$, $-\text{CC}-$, $-\text{CCCH}_2-$, $-\text{CH}_2\text{CC}-$, $-\text{CCCH}_2\text{CH}_2-$, $-\text{CH}_2\text{CCCH}_2-$, or $-(\text{CH}_2)_2\text{CC}-$ chains. Where appropriate each of said chains may be optionally interrupted by one or two atoms and/or groups L^4 to form an optionally substituted heteroaliphatic chain. Particular examples include optionally substituted $-\text{L}^4\text{CH}_2-$, $-\text{CH}_2\text{L}^4\text{CH}_2-$, $-\text{L}^4(\text{CH}_2)_2-$, $-\text{CH}_2\text{L}^4(\text{CH}_2)_2-$, $-(\text{CH}_2)_2\text{L}^4\text{CH}_2-$, $-\text{L}^4(\text{CH}_2)_3-$ and $-(\text{CH}_2)_2\text{L}^4(\text{CH}_2)_2-$ chains. The optional substituents which may be present on aliphatic or heteroaliphatic chains represented by Alk^1 include one, two, three or more substituents where each substituent may be the same or different and is selected from halogen atoms, e.g. fluorine, chlorine, bromine or iodine atoms, or C_{1-6} alkoxy, e.g. methoxy or ethoxy, thiol, C_{1-6} alkylthio e.g. methylthio or ethylthio, amino or substituted amino groups. Substituted amino groups include $-\text{NHR}^{12}$ and $-\text{N}(\text{R}^{12})_2$ groups where R^{12} is an optionally substituted straight or branched alkyl group as defined below for R^{11} . Where two R^{12} groups are present these may be the same or different. Particular examples of substituted chains represented by Alk^1 include those specific chains just described substituted by one, two, or three halogen atoms such as fluorine atoms, for example chains of the type $-\text{CH}(\text{CF}_3)-$, $-\text{C}(\text{CF}_3)_2-$, $-\text{CH}_2\text{CH}(\text{CF}_3)-$, $-\text{CH}_2\text{C}(\text{CF}_3)_2-$, $-\text{CH}(\text{CF}_3)-$ and $-\text{C}(\text{CF}_3)_2\text{CH}_2-$.

Halogen atoms represented by R^7 in compounds of the invention include fluorine, chlorine, bromine, or iodine atoms.

Examples of the substituents represented by R^4 and R^5 in compounds of formula (I) include atoms or groups $-\text{L}^2\text{Alk}^3\text{L}^3\text{R}^7$, $-\text{L}^2\text{Alk}^3\text{R}^7$, $-\text{L}^2\text{R}^7$, $-\text{Alk}^3\text{R}^7$ and $-\text{R}^7$ wherein L^2 , Alk^3 , L^3 and R^7 are as defined above. Particular examples of such

substituents include $-L^2CH_2L^3R^7$, $-L^2CH(CH_3)L^3R^7$, $-L^2CH(CH_2)_2L^3R^7$, $-L^2CH_2R^7$, $-L^2CH(CH_3)R^7$, $-L^2(CH_2)_2R^7$, $-CH_2R^7$, $-CH(CH_3)R^7$ and $-(CH_2)_2R^7$ groups.

Thus each of R^4 and R^5 in compounds of the invention may be for example a hydrogen atom, a halogen atom, e.g. a fluorine, chlorine, bromine or iodine atom, or a C_{1-6} alkyl, e.g. methyl, ethyl, n-propyl, i-propyl, n-butyl or t-butyl, C_{1-6} alkylamino, e.g. methylamino or ethylamino, C_{1-6} hydroxyalkyl, e.g. hydroxymethyl or hydroxyethyl, carboxy C_{1-6} alkyl, e.g. carboxyethyl, C_{1-6} alkylthio e.g. methylthio or ethylthio, carboxy C_{1-6} alkylthio, e.g. carboxymethylthio, 2-carboxyethylthio or 3-carboxypropylthio, C_{1-6} alkoxy, e.g. methoxy or ethoxy, C_{6-12} aryl C_{1-6} alkyloxy e.g. benzyloxy, hydroxy C_{1-6} alkoxy, e.g. 2-hydroxyethoxy, halo C_{1-6} alkyl, e.g., trifluoromethyl, halo C_{1-6} alkoxy, e.g. trifluoromethoxy, C_{1-6} alkylamino, e.g. methylamino or ethylamino, amino ($-NH_2$), amino C_{1-6} alkyl, e.g. aminomethyl or aminoethyl, C_{1-6} dialkylamino, e.g. dimethylamino or diethylamino, C_{1-6} alkylamino C_{1-6} alkyl, e.g. ethylaminoethyl, C_{1-6} dialkylamino C_{1-6} alkyl, e.g. diethylaminoethyl, amino C_{1-6} alkoxy, e.g., aminoethoxy, C_{1-6} alkylamino C_{1-6} alkoxy, e.g. methylaminoethoxy, C_{1-6} dialkylamino C_{1-6} alkoxy, e.g. dimethylaminoethoxy, diethylaminoethoxy, diisopropylaminoethoxy, or dimethylaminopropoxy, nitro, cyano, amidino, hydroxyl ($-OH$), formyl [$HC(O)-$], carboxyl ($-CO_2H$), $-CO_2Alk^5$ [where Alk^5 is as defined below], C_{1-6} alkanoyl e.g. acetyl, thiol ($-SH$), thio C_{1-6} alkyl, e.g., thiomethyl or thioethyl, thio C_{1-6} alkyl C_{6-12} aryl, e.g. thiobenzyl, sulphonyl ($-SO_3H$), C_{1-6} alkylsulphinyl, e.g., methylsulphinyl, C_{1-6} alkylsulphonyl, e.g. methylsulphonyl, aminosulphonyl ($-SO_2NH_2$), C_{1-6} alkylaminosulphonyl, e.g. methylaminosulphonyl or ethylaminosulphonyl, C_{1-6} dialkylaminosulphonyl, e.g. dimethylaminosulphonyl or diethylaminosulphonyl, phenylaminosulphonyl, carboxamido ($-CONH_2$), C_{1-6} alkylaminocarbonyl, e.g. methylaminocarbonyl or ethyl aminocarbonyl, C_{1-6} dialkylaminocarbonyl, e.g., dimethylaminocarbonyl or diethylaminocarbonyl, amino C_{1-6} alkylaminocarbonyl, e.g. aminoethylamino-

carbonyl, C₁₋₆ dialkylamino C₁₋₆ alkylaminocarbonyl, e.g.,
diethylaminoethylaminocarbonyl, aminocarbonylamino, C₁₋₆
alkylaminocarbonylamino, e.g., methyl-aminocarbonylamino or
ethylaminocarbonylamino, C₁₋₆ dialkylaminocarbonyl-amino, e.g.,
5 dimethylaminocarbonylamino or diethylaminocarbonylamino,
C₁₋₆ alkylaminocarbonyl C₁₋₆ alkylamino, e.g. methylaminocarbonylmethylamino,
aminothiocarbonylamino, C₁₋₆ alkylaminothiocarbonylamino, e.g. methylamino-
thiocarbonylamino or ethylaminothiocarbonylamino, C₁₋₆ dialkylaminothio-
carbonylamino, e.g. dimethylaminothiocarbonylamino or diethylaminothio-
10 carbonylamino, C₁₋₆ alkylaminothiocarbonyl C₁₋₆ alkylamino, e.g. ethylamino-
thiocarbonylmethylamino, C₁₋₆ alkylsulphonylamino, e.g. methylsulphonylamino
or ethyl sulphonylamino, C₁₋₆ dialkylsulphonylamino, e.g. dimethylsulphonyl-
amino or diethylsulphonylamino, aminosulphonylamino (-NHSO₂NH₂),
C₁₋₆ alkylaminosulphonylamino, e.g. methylaminosulphonylamino or ethyl-
15 aminosulphonylamino, C₁₋₆ dialkylaminosulphonylamino, e.g. dimethyl-
aminosulphonylamino or diethylaminosulphonylamino, C₁₋₆ alkanoylamino, e.g.
acetylamino, amino C₁₋₆ alkanoylamino e.g. aminoacetylamino, C₁₋₆ dialkylamino-
C₁₋₆ alkanoylamino, e.g. dimethylaminoacetylamino, C₁₋₆ alkanoylamino C₁₋₆ alkyl,
e.g. acetyl aminomethyl, C₁₋₆ alkanoylamino C₁₋₆ alkylamino, e.g.
20 acetamidoethylamino, C₁₋₆ alkoxycarbonylamino, e.g., methoxycarbonylamino,
ethoxycarbonylamino or t-butoxycarbonylamino group.

Aromatic groups represented by the group Ar in compounds of the
invention include, for example, monocyclic or bicyclic fused ring C₆₋₁₂ aromatic
groups, such as phenyl, 1- or 2-naphthyl, 1- or 2-tetrahydronaphthyl, indanyl or
25 indenyl groups. Aromatic groups represented by the group Ar may be optionally
substituted by one, two, three or more R¹³ atoms or groups as defined below.

Heteroaromatic groups represented by the group Ar in the compounds of
the invention include for example C₁₋₉ heteroaromatic groups containing for

example one, two, three or four heteroatoms selected from oxygen, sulphur or nitrogen atoms. In general, the heteroaromatic groups may be for example monocyclic or bicyclic fused ring heteroaromatic groups. Monocyclic heteroaromatic groups include for example five- or six-membered heteroaromatic groups containing one, two, three or four heteroatoms selected from oxygen, sulphur or nitrogen atoms. Bicyclic heteroaromatic groups include for example eight- to thirteen-membered fused-ring heteroaromatic groups containing one, two or more heteroatoms selected from oxygen, sulphur or nitrogen atoms.

Particular examples of heteroaromatic groups of these types include pyrrolyl, furyl, thienyl, imidazolyl, N-C₁₋₆ alkylimidazolyl, oxazolyl, isoxazolyl, thiazolyl, isothiazolyl, pyrazolyl, 1,2,3-triazolyl, 1,2,4-triazolyl, 1,2,3-oxadiazolyl, 1,2,4-oxadiazolyl, 1,2,5-oxadiazolyl, 1,3,4-oxadiazolyl, 1,3,4-thiadiazole, pyridyl, pyrimidinyl, pyridazinyl, pyrazinyl, 1,3,5-triazinyl, 1,2,4-triazinyl; 1,2,3-triazinyl, benzofuryl, [2,3-dihydro]benzofuryl, benzothienyl, benzotriazolyl, indolyl, isoindolyl, benzimidazolyl, imidazo[1,2-a]pyridyl, benzothiazolyl, benzoxazolyl, benzopyranyl, [3,4-dihydro]benzopyranyl, quinazolinyl, quinoxalyl, naphthyridinyl, pyrido[3,4-b]pyridyl, pyrido[3,2-b]pyridyl, pyrido[4,3-b]-pyridyl, quinolinyl, isoquinolinyl, tetrazolyl, 5,6,7,8-tetrahydroquinolinyl, 5,6,7,8-tetrahydroisoquinolinyl, and imidyl, e.g. succinimidyl, phthalimidyl, or naphthalimidyl such as 1,8-naphthalimidyl.

Optional substituents which may be present on the aromatic or heteroaromatic groups represented by Ar include one, two, three or more substituents, each selected from an atom or group R¹³ in which R¹³ is R^{13a} or -Alk⁴(R^{13a})_m, where R^{13a} is a halogen atom, or an amino (-NH₂), substituted amino, nitro, cyano, amidino, hydroxyl (-OH), substituted hydroxyl, formyl, carboxyl (-CO₂H), esterified carboxyl, thiol (-SH), substituted thiol, -COR¹⁴ [where R¹⁴ is an -Alk³(R^{13a})_m, aryl or heteroaryl group], -CSR¹⁴, -SO₃H, -SO₂R¹⁴, -SO₂NH₂, -SO₂NHR¹⁴, -SO₂N(R¹⁴)₂, -CONH₂, -CSNH₂, -CONHR¹⁴, -CSNHR¹⁴,

-CON(R¹⁴)₂, -CSN(R¹⁴)₂, -N(R¹²)SO₂R¹⁴, -N(SO₂R¹⁴)₂, -NH(R¹¹)SO₂NH₂,
-N(R¹¹)SO₂NHR¹⁴, -N(R¹¹)SO₂N(R¹⁴)₂, -N(R¹¹)COR¹⁴, -N(R¹¹)CON(R¹⁴)₂,
-N(R¹¹)CSN(R¹⁴)₂, -N(R¹¹)CSR¹⁴, -N(R¹¹)C(O)OR¹⁴, -SO₂NHet¹ [where -NHet¹ is
an optionally substituted C₅₋₇cyclicamino group optionally containing one or more
other -O- or -S- atoms or -N(R¹¹)-, -C(O)- or -C(S)groups], -CONHet¹, -CSNHet¹,
-N(R¹¹)SO₂NHet¹, -N(R¹¹)CONHet¹, -N(R¹¹)CSNHet¹, -Het², [where Het² is an
optionally substituted monocyclic C₅₋₇carbocyclic group optionally containing one
or more -O- or -S- atoms or -N(R¹¹)-, -C(O)- or -C(S)- groups] -SO₂N(R¹¹)Het²,
-CON(R¹¹)Het², -CSN(R¹¹)Het², -N(R¹¹)CON(R¹¹)Het², -N(R¹¹)CSN(R¹¹)Het², aryl
or heteroaryl group; Alk⁴ is a straight or branched C₁₋₆ alkylene, C₂₋₆ alkenylene or
C₂₋₆ alkynylene chain, optionally interrupted by one, two or three -O- or -S- atoms
or -S(O)_n [where n is an integer 1 or 2] or -N(R¹⁵)- groups [where R¹⁵ is a
hydrogen atom or C₁₋₆alkyl, e.g. methyl or ethyl group]; and m is zero or an
integer 1, 2 or 3. It will be appreciated that when two R¹¹ or R¹⁴ groups are
present in one of the above substituents, the R¹¹ or R¹⁴ groups may be the same or
different.

When in the group -Alk⁴(R^{13a})_m m is an integer 1, 2 or 3, it is to be
understood that the substituent or substituents R^{13a} may be present on any suitable
carbon atom in -Alk⁴. Where more than one R^{13a} substituent is present these may
be the same or different and may be present on the same or different atom in
-Alk⁴. Clearly, when m is zero and no substituent R^{13a} is present the alkylene,
alkenylene or alkynylene chain represented by Alk⁴ becomes an alkyl, alkenyl or
alkynyl group.

When R^{13a} is a substituted amino group it may be for example a group
-NHR¹⁴ [where R¹⁴ is as defined above] or a group -N(R¹⁴)₂ wherein each
R¹⁴ group is the same or different.

When R^{13a} is a halogen atom it may be for example a fluorine, chlorine,
bromine, or iodine atom.

When R^{13a} is a substituted hydroxyl or substituted thiol group it may be for example a group $-OR^{14}$ or a $-SR^{14}$ or $-SC(=NH)NH_2$ group respectively.

Esterified carboxyl groups represented by the group R^{13a} include groups of formula $-CO_2Alk^5$ wherein Alk^5 is a straight or branched, optionally substituted C_{1-8} alkyl group such as a methyl, ethyl, n-propyl, i-propyl, n-butyl, i-butyl, s-butyl or t-butyl group; a C_{6-12} aryl C_{1-8} alkyl group such as an optionally substituted benzyl, phenylethyl, phenylpropyl, 1-naphthylmethyl or 2-naphthylmethyl group; a C_{6-12} aryl group such as an optionally substituted phenyl, 1-naphthyl or 2-naphthyl group; a C_{6-12} aryloxy C_{1-8} alkyl group such as an optionally substituted phenyloxymethyl, phenyloxyethyl, 1-naphthyl-oxymethyl, or 2-naphthyloxymethyl group; an optionally substituted C_{1-8} alkanoyloxy C_{1-8} alkyl group, such as a pivaloyloxymethyl, propionyloxyethyl or propionyloxypropyl group; or a C_{6-12} aroyloxy C_{1-8} alkyl group such as an optionally substituted benzoyloxyethyl or benzoyloxypropyl group. Optional substituents present on the $Alks$ group include R^{13a} substituents described above.

When Alk^4 is present in or as a substituent it may be for example a methylene, ethylene, n-propylene, i-propylene, n-butylene, i-butylene, sbutylene, t-butylene, ethenylene, 2-propenylene, 2-butenylene, 3-butenylene, ethynylene, 2-propynylene, 2-butynylene or 3-butynylene chain, optionally interrupted by one, two, or three $-O-$ or $-S-$, atoms or $-S(O)-$, $-S(O)_2-$ or $-N(R^{12})-$ groups.

Aryl or heteroaryl groups represented by the groups R^{13a} or R^{14} include mono- or bicyclic optionally substituted C_{6-12} aromatic or C_{1-9} heteroaromatic groups as described above for the group Ar. The aromatic and heteroaromatic groups may be attached to the remainder of the compound of formula (1) by any carbon or hetero, e.g. nitrogen atom, as appropriate.

When $-NHet^1$ or $-Het^2$ forms part of a substituent R^{13} each may be for example an optionally substituted pyrrolidinyl, pyrazolidinyl, piperazinyl, morpholinyl, thiomorpholinyl, piperidinyl or thiazolidinyl group. Additionally

Het² may represent for example, an optionally substituted cyclopentyl or cyclohexyl group. Optional substituents which may be present on -NHet¹ or -Het² include those R⁷ substituents described above.

Particularly useful atoms or groups represented by R¹³ include fluorine,
5 chlorine, bromine or iodine atoms, or C₁₋₆ alkyl, e.g. methyl, ethyl, n-propyl, i-propyl, n-butyl or t-butyl, optionally substituted phenyl, pyridyl, pyrimidinyl, pyrrolyl, furyl, thiazolyl, or thienyl, morpholinyl, thiomorpholinyl, piperazinyl, pyrrolidinyl, piperidinyl, C₁₋₆ alkylamino, e.g. methylamino or ethylamino, C₁₋₆ hydroxyalkyl, e.g. hydroxymethyl or hydroxyethyl, carboxyC₁₋₆ alkyl,
10 e.g. carboxyethyl, C₁₋₆ alkylthio e.g. methylthio or ethylthio, carboxy C₁₋₆ alkylthio, e.g. carboxymethylthio, 2-carboxyethylthio or 3-carboxypropylthio, C₁₋₆ alkoxy, e.g. methoxy or ethoxy, hydroxy C₁₋₆ alkoxy, e.g. 2-hydroxyethoxy, optionally substituted phenoxy, pyridyloxy, thiazolyoxy, phenylthio or pyridylthio, C₅₋₇ cycloalkoxy, e.g. cyclopentyloxy, halo C₁₋₆ alkyl, e.g. trifluoromethyl, halo
15 C₁₋₆ alkoxy, e.g. trifluoromethoxy, C₁₋₆ alkylamino, e.g. methylamino or ethylamino or propylamino, optionally substituted C₆₋₁₂ aryl C₁₋₆ alkylamino, e.g. benzylamino, fluorobenzylamino or hydroxyphenylethylamino, amino (-NH₂), amino C₁₋₆ alkyl, e.g. aminomethyl or aminomethyl, C₁₋₆ dialkylamino, e.g. dimethylamino or diethylamino, amino C₁₋₆ alkylamino
20 e.g. aminomethylamino, aminoethylamino or aminopropylamino, Het¹ NC₁₋₆ alkylamino e.g., morpholinopropylamino, C₁₋₆ alkylamino C₁₋₆ alkyl, e.g. ethylaminoethyl, C₁₋₆ dialkylamino C₁₋₆ alkyl, e.g. diethylaminoethyl, amino C₁₋₆ alkoxy, e.g. aminoethoxy, C₁₋₆ alkylamino C₁₋₆ alkoxy, e.g. methylaminoethoxy, C₁₋₆ dialkylamino C₁₋₆ alkoxy,
25 e.g. dimethylaminoethoxy, diethylaminoethoxy, diisopropylaminoethoxy, or dimethylaminopropoxy, hydroxy C₁₋₆ alkylamino, e.g. hydroxyethylamino, hydroxypropylamino or hydroxybutylamino, imido, such as phthalimido or naphthalimido, e.g. 1,8-naphthalimido, nitro, cyano, amidino, hydroxyl (-OH),

formyl [HC(O)-], carboxyl (-CO₂H), -CO₂Alk⁵ [where Alk⁵ is as defined above], C₁₋₆ alkanoyl e.g. acetyl, propyryl or butyryl, optionally substituted benzoyl, thiol (-SH), thioC₁₋₆alkyl, e.g., thiomethyl or thioethyl, -SC(=NH)NH₂, sulphonyl (-SO₃H), C₁₋₆alkylsulphinyl, e.g. methylsulphinyl, ethylsulphinyl or propylsulphinyl, C₁₋₆ alkylsulphonyl, e.g. methylsulphonyl, ethylsulphonyl, propylsulphonyl, hexylsulphonyl or isobutylsulphonyl, aminosulphonyl (-SO₂NH₂), C₁₋₆ alkylaminosulphonyl, e.g. methylaminosulphonyl, ethylaminosulphonyl or propylaminosulphonyl, C₁₋₆ dialkylaminosulphonyl, e.g. dimethylaminosulphonyl or diethylaminosulphonyl, optionally substituted phenylaminosulphonyl, carboxamido (-CONH₂), C₁₋₆ alkylaminocarbonyl, e.g. methylaminocarbonyl, ethylaminocarbonyl or propylaminocarbonyl, C₁₋₆dialkylaminocarbonyl, e.g. dimethylaminocarbonyl, diethylaminocarbonyl or dipropylaminocarbonyl, amino C₁₋₆ alkylaminocarbonyl, e.g. aminoethylaminocarbonyl, C₁₋₆ dialkylamino C₁₋₆ alkylaminocarbonyl, e.g. diethylaminoethylaminocarbonyl, aminocarbonylamino, C₁₋₆ alkylaminocarbonylamino, e.g. methylaminocarbonylamino or ethylaminocarbonylamino, C₁₋₆ dialkylaminocarbonylamino, e.g. dimethylaminocarbonylamino or diethylaminocarbonylamino, C₁₋₆ alkylaminocarbonyl C₁₋₆ alkylamino, e.g. methylaminocarbonylmethylamino, aminothiocabonylamino, C₁₋₆ alkylaminothiocarbonylamino, e.g. methylaminothiocarbonylamino or ethylaminothiocarbonylamino, C₁₋₆ dialkylaminothiocarbonylamino, e.g. dimethylaminothiocarbonylamino or diethylaminothiocarbonylamino, C₁₋₆ alkylaminothiocarbonyl C₁₋₆ alkylamino, e.g. ethylaminothiocarbonylmethylamino, -CONHC(=NH)NH₂, C₁₋₆ alkylsulphonylamino, e.g. methylsulphonylamino or ethylsulphonylamino, C₁₋₆ dialkylsulphonylamino, e.g. dimethylsulphonylamino or diethylsulphonylamino, optionally substituted phenylsulphonylamino, aminosulphonylamino (-NHSO₂NH₂), C₁₋₆ alkylaminosulphonylamino, e.g. methylaminosulphonylamino or ethylaminosulphonylamino,

C₁₋₆ dialkylaminosulphonylamino, e.g. dimethylaminosulphonylamino or diethylaminosulphonylamino, optionally substituted morpholinesulphonylamino or morpholinesulphonyl C₁₋₆ alkyl-amino, optionally substituted phenylamino-sulphonylamino, C₁₋₆ alkanoylamino, e.g. acetylamino, amino C₁₋₆ alkanoylamino
5 e.g. aminoacetylamino, C₁₋₆ dialkylamino C₁₋₆ alkanoylamino, e.g., dimethylaminoacetylamino, C₁₋₆ alkanoylamino C₁₋₆ alkyl, e.g. acetylaminomethyl, C₁₋₆ alkanoylamino C₁₋₆ alkylamino, e.g. acetamidoethylamino, C₁₋₆ alkoxycarbonylamino, e.g. methoxycarbonylamino, ethoxycarbonylamino or t-butoxycarbonylamino or optionally substituted
10 benzyloxy, pyridylmethoxy, thiazolylmethoxy, benzyloxycarbonylamino, benzyloxycarbonylamino C₁₋₆ alkyl e.g. benzyloxycarbonylaminoethyl, thiobenzyl, pyridylmethylthio or thiazolylmethylthio groups.

Where desired, two R¹³ substituents may be linked together to form a cyclic group such as a cyclic ether, e.g. a C₁₋₆ alkylenedioxy group such as
15 methylenedioxy or ethylenedioxy.

It will be appreciated that where two or more R¹³ substituents are present, these need not necessarily be the same atoms and/or groups. In general, the substituent(s) may be present at any available ring position in the 5 aromatic or heteroaromatic group represented by Ar.

20 The presence of certain substituents in the compounds of formulae (1) and (2) may enable salts of the compounds to be formed. Suitable salts include pharmaceutically acceptable salts, for example acid addition salts derived from inorganic or organic acids, and salts derived from inorganic and organic bases.

Acid addition salts include hydrochlorides, hydrobromides,
25 hydroiodides, alkylsulphonates, e.g. methanesulphonates, ethanesulphonates, or isothionates, arylsulphonates, e.g. p-toluenesulphonates, besylates or napsylates, phosphates, sulphates, hydrogen sulphates, acetates, trifluoroacetates, propionates,

citrates, maleates, fumarates, malonates, succinates, lactates, oxalates, tartrates and benzoates.

Salts derived from inorganic or organic bases include alkali metal salts such as sodium or potassium salts, alkaline earth metal salts such as magnesium or calcium salts, and organic amine salts such as morpholine, piperidine,
5 dimethylamine or diethylamine salts.

Particularly useful salts of compounds according to the invention include pharmaceutically acceptable salts, especially acid addition pharmaceutically acceptable salts.

10 R in the compounds of formulae (1) and (2) is preferably a $-CO_2H$ group.

In compounds of formulae (1) and (2), m is preferably 1 and Alk^2 is preferably $-CH_2-$.

R^4 and R^5 in the compounds of formulae (1) and (2) may be the same or different and is each preferably a hydrogen or halogen atom or an alkyl, alkoxy,
15 hydroxy, nitro, cyano or $-NR^8R^9$ group.

R^6 and R^a in the compounds of formulae (1) and (2) is each preferably a hydrogen atom.

Particularly useful classes of compounds according to the invention are those wherein Ar is an optionally substituted monocyclic aromatic or
20 heteroaromatic group. One especially useful aromatic group when represented by Ar is phenyl. Especially useful heteroaromatic groups represented by Ar include optionally substituted monocyclic nitrogen containing heteroaromatic groups, particularly optionally substituted pyridyl, pyrimidinyl, pyridazinyl and triazinyl groups. Where the group is a triazinyl group it is preferably a 1,3,5 triazine.

25 Optional substituents which may be present on preferred Ar aromatic or heteroaromatic groups include for example one or two substituents selected from those R^{13} substituents described above.

Particularly useful R¹³ substituents of these types include a halogen atom, especially fluorine or chlorine, morpholinyl, thiomorpholinyl, optionally substituted piperidinyl, especially piperidinyl or 4-carboxypiperidinyl, pyrrolidinyl, optionally substituted piperazinyl, especially t-butyloxycarbonyl-piperazinyl, thio C₁₋₆ alkyl, especially thiomethyl, thioethyl or thiopropyl, optionally substituted thiobenzyl, especially thiobenzyl, halo C₁₋₆ alkyl, especially trifluoromethyl, C₁₋₆ alkyloxy, especially methoxy, ethoxy or propoxy, optionally substituted benzyloxy, especially benzyloxy, halo C₁₋₆ alkoxy, especially trifluoromethoxy and difluoromethoxy, C₁₋₆ alkylamino, especially methylamino, ethylamino or propylamino, C₁₋₆ dialkylamino, especially dimethylamino or diethylamino, optionally substituted C₆₋₁₂ aryl C₁₋₆ alkylamino, especially benzylamino, 4-substituted benzyl, especially 4-fluorobenzylamino or 4-hydroxyphenylethylamino, aminoalkylamino, especially 3-aminopropylamino, Het¹ N(C₁₋₆ alkylamino), especially 3-morpholinopropylamino, optionally substituted phenoxy, especially phenoxy, hydroxy C₁₋₆ alkylamino, especially 2-hydroxyethylamino, 3-hydroxypropylamino and 3-hydroxybutylamino, nitro, carboxyl, -CO₂Alk⁵ [where Alk⁵ is as defined above], especially carboxymethyl and carboxyethyl, carboxamido, C₁₋₆ alkylaminocarbonyl, especially methylaminocarbonyl, ethylaminocarbonyl and propylaminocarbonyl, C₁₋₆ dialkylaminocarbonyl, especially dimethylaminocarbonyl, diethylaminocarbonyl or dipropylaminocarbonyl, C₁₋₆ alkanoyl, especially acetyl, propyl or butyryl, optionally substituted benzoyl, especially benzoyl, C₁₋₆ alkylsulphinyl, especially methylsulphinyl, ethylsulphinyl or propylsulphinyl, Cl-alkylsulphonyl, especially methylsulphonyl, ethylsulphonyl, propylsulphonyl, hexylsulphonyl or isobutylsulphonyl, C₁₋₆ alkylaminosulphonyl, especially ethylaminosulfonyl or propylamino-sulphonyl, C₁₋₆ dialkylaminosulphonyl, especially diethylaminosulphonyl, C₁₋₆ alkylaminocarbonyl, especially methylaminocarbonyl,

ethylaminocarbonyl or propylaminocarbonyl, C₁₋₆ dialkylaminocarbonyl, especially dimethylaminocarbonyl or diethylaminocarbonyl.

Particularly useful Alk⁴ groups when present in compounds of the invention include -CH₂-, -CH₂CH₂-, -(CH₂)₂CH₂-, -CH(CH₃)CH₂- and -(CH₂)₃CH₂- groups.

Particularly useful compounds of the invention include:

S-3-[4-(N,N-dimethylaminocarbonyloxy)phenyl]-2-(6-propylsulphonylpyrimidin-4-ylamino)propanoic acid;

S-3-[4-(N,N-dimethylaminocarbonyloxy)phenyl]-2-(6-diethylaminosulphonylpyrimidin-4-ylamino)propanoic acid; and

S-3-[4-(N-morpholinocarbonyloxy)phenyl]-2-(6-diethylaminosulphonylpyrimidin-4-ylamino)propanoic acid;

and the salts, solvates, hydrates and N-oxides thereof.

Compounds according to the invention are potent and selective inhibitors of α 4 integrins. The ability of the compounds to act in this way may be simply determined by employing tests such as those described in the Examples hereinafter.

The compounds are of use in modulating cell adhesion and in particular are of use in the prophylaxis and treatment of diseases or disorders involving inflammation in which the extravasation of leukocytes plays a role and the invention extends to such a use and to the use of the compounds for the manufacture of a medicament for treating such diseases or disorders.

Diseases or disorders of this type include inflammatory arthritis such as rheumatoid arthritis vasculitis or polydermatomyositis, multiple sclerosis, allograft rejection, diabetes, inflammatory dermatoses such as psoriasis or dermatitis, asthma and inflammatory bowel disease.

For the prophylaxis or treatment of disease the compounds according to the invention may be administered as pharmaceutical compositions, and according to a further aspect of the invention we provide a pharmaceutical composition which comprises a compound of formula (1) together with one or more pharmaceutically acceptable carriers, excipients or diluents.

Pharmaceutical compositions according to the invention may take a form suitable for oral, buccal, parenteral, nasal, topical or rectal administration, or a form suitable for administration by inhalation or insufflation.

For oral administration, the pharmaceutical compositions may take the form of, for example; tablets, lozenges or capsules prepared by conventional means with pharmaceutically acceptable excipients such as binding agents (e.g. pregelatinised maize starch, polyvinylpyrrolidone or hydroxypropyl methylcellulose); fillers (e.g. lactose, microcrystalline cellulose or calcium hydrogen phosphate); lubricants (e.g. magnesium stearate, talc or silica); disintegrants (e.g. potato starch or sodium glycollate); or wetting agents (e.g. sodium lauryl sulphate). The tablets may be coated by methods well known in the art. Liquid preparations for oral administration may take the form of, for example, solutions, syrups or suspensions, or they may be presented as a dry product for constitution with water or other suitable vehicle before use. Such liquid preparations may be prepared by conventional means with pharmaceutically acceptable additives such as suspending agents, emulsifying agents, non-aqueous vehicles and preservatives. The preparations may also contain buffer salts, flavouring, colouring and sweetening agents as appropriate.

Preparations for oral administration may be suitably formulated to give controlled release of the active compound.

For buccal administration the compositions may take the form of tablets or lozenges formulated in conventional manner.

The compounds for formulae (1) and (2) may be formulated for parenteral administration by injection e.g. by bolus injection or infusion. Formulations for injection may be presented in unit dosage form, e.g. in glass ampoule or multi dose containers, e.g. glass vials. The compositions for injection may take such forms as suspensions, solutions or emulsions in oily or aqueous vehicles, and may contain formulatory agents such as suspending, stabilising, preserving and/or dispersing agents. Alternatively, the active ingredient may be in powder form for constitution with a suitable vehicle, e.g. sterile pyrogen-free water, before use.

In addition to the formulations described above, the compounds of formulae (1) and (2) may also be formulated as a depot preparation. Such long acting formulations may be administered by implantation or by intramuscular injection.

For nasal administration or administration by inhalation, the compounds for use according to the present invention are conveniently delivered in the form of an aerosol spray presentation for pressurised packs or a nebuliser, with the use of suitable propellant, e.g. dichlorodifluoromethane, trichloro-fluoromethane, dichlorotetrafluoroethane, carbon dioxide or other suitable gas or mixture of gases.

The compositions may, if desired, be presented in a pack or dispenser device which may contain one or more unit dosage forms containing the active ingredient. The pack or dispensing device may be accompanied by instructions for administration.

The quantity of a compound of the invention required for the prophylaxis or treatment of a particular condition will vary depending on the compound chosen, and the condition of the patient to be treated. In general, however, daily dosages may range from around 100 ng/kg to 100 mg/kg e.g. around 0.01 mg/kg to 40 mg/kg body weight for oral or buccal administration, from around 10 ng/kg to 50 mg/kg body weight for parenteral administration and around 0.05 mg to

around 1000 mg e.g. around 0.5 mg to around 1000 mg for nasal administration or administration by inhalation or insufflation.

DETAILED DESCRIPTION OF THE INVENTION

5 As used herein, the following terms have the following meanings unless more limited definitions are used:

As used herein, "alkyl" refers to alkyl groups preferably having from 1 to 10 carbon atoms and more preferably 1 to 6 carbon atoms. This term is exemplified by groups such as methyl, t-butyl, n-heptyl, octyl and the like.

10 "Substituted alkyl" refers to an alkyl group, preferably of from 1 to 10 carbon atoms, having from 1 to 5 substituents selected from the group consisting of alkoxy, substituted alkoxy, acyl, acylamino, thiocarbonylamino, acyloxy, amino, amidino, alkyl amidino, thioamidino, aminoacyl, aminocarbonylamino, aminothiocarbonylamino, aminocarbonyloxy, aryl, substituted aryl, aryloxy, 15 substituted aryloxy, aryloxyaryl, substituted aryloxyaryl, cyano, halogen, hydroxyl, nitro, carboxyl, carboxylalkyl, carboxyl-substituted alkyl, carboxyl-cycloalkyl, carboxyl-substituted cycloalkyl, carboxylaryl, carboxyl-substituted aryl, carboxylheteroaryl, carboxyl-substituted heteroaryl, carboxylheterocyclic, carboxyl-substituted heterocyclic, cycloalkyl, substituted cycloalkyl, guanidino, 20 guanidinosulfone, thiol, thioalkyl, substituted thioalkyl, thioaryl, substituted thioaryl, thiocycloalkyl, substituted thiocycloalkyl, thioheteroaryl, substituted thioheteroaryl, thioheterocyclic, substituted thioheterocyclic, heteroaryl, substituted heteroaryl, heterocyclic, substituted heterocyclic, cycloalkoxy, substituted cycloalkoxy, heteroaryloxy, substituted heteroaryloxy, 25 heterocyclyloxy, substituted heterocyclyloxy; oxycarbonylamino, oxythiocarbonylamino, -OS(O)₂-alkyl, -OS(O)₂-substituted alkyl, -OS(O)₂-aryl, -OS(O)₂-substituted aryl, -OS(O)₂-heteroaryl, -OS(O)₂-substituted heteroaryl, -OS(O)₂-heterocyclic, -OS(O)₂-substituted heterocyclic, -OSO₂-NRR where R is

hydrogen or alkyl, -NRS(O)₂-alkyl, -NRS(O)₂-substituted alkyl, -NRS(O)₂-aryl,
-NRS(O)₂-substituted aryl, -NRS(O)₂-heteroaryl, -NRS(O)₂-substituted heteroaryl,
-NRS(O)₂-heterocyclic, -NRS(O)₂-substituted heterocyclic, -NRS(O)₂-NR-alkyl,
-NRS(O)₂-NR-substituted alkyl, -NRS(O)₂-NR-aryl, -NRS(O)₂-NR-substituted
5 aryl, -NRS(O)₂-NR-heteroaryl, -NRS(O)₂-NR-substituted heteroaryl, -NRS(O)₂-
NR-heterocyclic, -NRS(O)₂-NR-substituted heterocyclic where R is hydrogen or
alkyl, mono- and di-alkylamino, mono- and di-(substituted alkyl)amino, mono- and
di-arylamino, mono- and di-substituted arylamino, mono- and di-heteroarylamino,
mono- and di-substituted heteroarylamino, mono- and di-heterocyclic amino,
10 mono- and di-substituted heterocyclic amino, unsymmetric di-substituted amines
having different substituents selected from alkyl, substituted alkyl, aryl, substituted
aryl, heteroaryl, substituted heteroaryl, heterocyclic and substituted heterocyclic
and substituted alkyl groups having amino groups blocked by conventional
blocking groups such as Boc, Cbz, formyl, and the like or alkyl/substituted alkyl
15 groups substituted with -SO₂-alkyl, -SO₂-substituted alkyl, -SO₂-alkenyl, -SO₂-
substituted alkenyl, -SO₂-cycloalkyl, -SO₂-substituted cycloalkyl, -SO₂-aryl, -SO₂-
substituted aryl, -SO₂-heteroaryl, -SO₂-substituted heteroaryl, -SO₂-heterocyclic, -
SO₂-substituted heterocyclic and -SO₂NRR where R is hydrogen or alkyl.

"Alkoxy" refers to the group "alkyl-O-" which includes, by way of
20 example, methoxy, ethoxy, *n*-propoxy, *iso*-propoxy, *n*-butoxy, *tert*-butoxy, *sec*-
butoxy, *n*-pentoxy, *n*-hexoxy, 1,2-dimethylbutoxy, and the like.

"Substituted alkoxy" refers to the group "substituted alkyl-O-".

"Alkenoxy" refers to the group "alkenyl-O-".

"Substituted alkenoxy" refers to the group "substituted alkenyl-O-".

25 "Acyl" refers to the groups H-C(O)-, alkyl-C(O)-, substituted alkyl-
C(O)-, alkenyl-C(O)-, substituted alkenyl-C(O)-, alkynyl-C(O)-, substituted
alkynyl-C(O)- cycloalkyl-C(O)-, substituted cycloalkyl-C(O)-, aryl-C(O)-,
substituted aryl-C(O)-, heteroaryl-C(O)-, substituted heteroaryl-C(O),

heterocyclic-C(O)-, and substituted heterocyclic-C(O)- wherein alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, cycloalkyl, substituted cycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclic and substituted heterocyclic are as defined herein.

5 "Acylamino" refers to the group -C(O)NRR where each R is independently selected from the group consisting of hydrogen, alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, aryl, substituted aryl, cycloalkyl, substituted cycloalkyl, heteroaryl, substituted heteroaryl, heterocyclic, substituted heterocyclic and where each R is joined to form together
10 with the nitrogen atom a heterocyclic or substituted heterocyclic ring wherein alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, cycloalkyl, substituted cycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclic and substituted heterocyclic are as defined herein.

15 "Thiocarbonylamino" refers to the group -C(S)NRR where each R is independently selected from the group consisting of hydrogen, alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, aryl, substituted aryl, cycloalkyl, substituted cycloalkyl, heteroaryl, substituted heteroaryl, heterocyclic, substituted heterocyclic and where each R is joined to form, together
20 with the nitrogen atom a heterocyclic or substituted heterocyclic ring wherein alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, cycloalkyl, substituted cycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclic and substituted heterocyclic are as defined herein.

25 "Acyloxy" refers to the groups alkyl-C(O)O-, substituted alkyl-C(O)O-, alkenyl-C(O)O-, substituted alkenyl-C(O)O-, alkynyl-C(O)O-, substituted alkynyl-C(O)O-, aryl-C(O)O-, substituted aryl-C(O)O-, cycloalkyl-C(O)O-, substituted cycloalkyl-C(O)O-, heteroaryl-C(O)O-, substituted heteroaryl-C(O)O-, heterocyclic-C(O)O-, and substituted heterocyclic-C(O)O- wherein alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl,

cycloalkyl, substituted cycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclic and substituted heterocyclic are as defined herein.

"Oxysulfonyl" refers to the groups alkyl-SO₂O-, substituted alkyl-SO₂O-, alkenyl-SO₂O-, substituted alkenyl-SO₂O-, alkynyl-SO₂O-, substituted alkynyl-SO₂O-, aryl-SO₂O-, substituted aryl-SO₂O-, cycloalkyl-SO₂O-, substituted cycloalkyl-SO₂O-, heteroaryl-SO₂O-, substituted heteroaryl-SO₂O-, heterocyclic-SO₂O-, and substituted heterocyclic-SO₂O- wherein alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, cycloalkyl, substituted cycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclic and substituted heterocyclic are as defined herein.

"Alkenyl" refers to alkenyl group preferably having from 2 to 10 carbon atoms and more preferably 2 to 6 carbon atoms and having at least 1 and preferably from 1-2 sites of alkenyl unsaturation.

"Substituted alkenyl" refers to alkenyl groups having from 1 to 5 substituents selected from the group consisting of alkoxy, substituted alkoxy, acyl, acylamino, thiocarbonylamino, acyloxy, amino, amidino, alkylamidino, thioamidino, aminoacyl, aminocarbonylamino, aminothiocarbonylamino, aminocarbonyloxy, aryl, substituted aryl, aryloxy, substituted aryloxy, aryloxyaryl, substituted aryloxyaryl, halogen, hydroxyl, cyano, nitro, carboxyl, carboxylalkyl, carboxyl-substituted alkyl, carboxyl-cycloalkyl, carboxyl-substituted cycloalkyl, carboxylaryl, carboxyl-substituted aryl, carboxylheteroaryl, carboxyl-substituted heteroaryl, carboxylheterocyclic, carboxyl-substituted heterocyclic, cycloalkyl, substituted cycloalkyl, guanidino, guanidinosulfone, thiol, thioalkyl, substituted thioalkyl, thioaryl, substituted thioaryl, thiocycloalkyl, substituted thiocycloalkyl, thioheteroaryl, substituted thioheteroaryl, thioheterocyclic, substituted thioheterocyclic, heteroaryl, substituted heteroaryl, heterocyclic, substituted heterocyclic, cycloalkoxy, substituted cycloalkoxy, heteroaryloxy, substituted heteroaryloxy, heterocyclyloxy, substituted

heterocycloxy, oxycarbonylamino, oxythiocarbonylamino, -OS(O)₂-alkyl, -OS(O)₂-substituted alkyl, -OS(O)₂-aryl, -OS(O)₂-substituted aryl, -OS(O)₂-heteroaryl, -OS(O)₂-substituted heteroaryl, -OS(O)₂-heterocyclic, -OS(O)₂-substituted heterocyclic, -OSO₂-NRR where R is hydrogen or alkyl, -NRS(O)₂-alkyl, -NRS(O)₂-substituted alkyl, -NRS(O)₂-aryl, -NRS(O)₂-substituted aryl, -NRS(O)₂-heteroaryl, -NRS(O)₂-substituted heteroaryl, -NRS(O)₂-heterocyclic, -NRS(O)₂-substituted heterocyclic, -NRS(O)₂-NR-alkyl, -NRS(O)₂-NR-substituted alkyl, -NRS(O)₂-NR-aryl, -NRS(O)₂-NR-substituted aryl, -NRS(O)₂-NR-heteroaryl, -NRS(O)₂-NR-substituted heteroaryl, -NRS(O)₂-NR-heterocyclic, -NRS(O)₂-NR-substituted heterocyclic where R is hydrogen or alkyl, mono- and di-alkylamino, mono- and di-(substituted alkyl)amino, mono- and di-arylamino, mono- and di-substituted arylamino, mono- and di-heteroarylamino, mono- and di-substituted heteroarylamino, mono- and di-heterocyclic amino, mono- and di-substituted heterocyclic amino, unsymmetric di-substituted amines having different substituents selected from alkyl, substituted alkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclic and substituted heterocyclic and substituted alkenyl groups having amino groups blocked by conventional blocking groups such as Boc, Cbz, formyl, and the like or alkenyl/substituted alkenyl groups substituted with -SO₂-alkyl, -SO₂-substituted alkyl, -SO₂-alkenyl, -SO₂-substituted alkenyl, -SO₂-cycloalkyl, -SO₂-substituted cycloalkyl, -SO₂-aryl, -SO₂-substituted aryl, -SO₂-heteroaryl, -SO₂-substituted heteroaryl, -SO₂-heterocyclic, -SO₂-substituted heterocyclic and -SO₂NRR where R is hydrogen or alkyl.

"Alkynyl" refers to alkynyl group preferably having from 2 to 10 carbon atoms and more preferably 3 to 6 carbon atoms and having at least 1 and preferably from 1-2 sites of alkynyl unsaturation.

"Substituted alkynyl" refers to alkynyl groups having from 1 to 5 substituents selected from the group consisting of alkoxy, substituted alkoxy, acyl, acylamino, thiocarbonylamino, acyloxy, amino, amidino, alkylamidino,

thioamidino, aminoacyl, aminocarbonylamino, aminothiocarbonylamino,
aminocarbonyloxy, aryl, substituted aryl, aryloxy, substituted aryloxy,
aryloxyaryl, substituted aryloxyaryl, halogen, hydroxyl, cyano, nitro, carboxyl,
carboxylalkyl, carboxyl-substituted alkyl, carboxyl-cycloalkyl, carboxyl-
5 substituted cycloalkyl, carboxylaryl, carboxyl-substituted aryl, carboxylheteroaryl,
carboxyl-substituted heteroaryl, carboxylheterocyclic, carboxyl-substituted
heterocyclic, cycloalkyl, substituted cycloalkyl, guanidino, guanidinosulfone,
thiol, thioalkyl, substituted thioalkyl, thioaryl, substituted thioaryl, thiocycloalkyl,
substituted thiocycloalkyl, thioheteroaryl, substituted thioheteroaryl,
10 thioheterocyclic, substituted thioheterocyclic, heteroaryl, substituted heteroaryl,
heterocyclic, substituted heterocyclic, cycloalkoxy, substituted cycloalkoxy,
heteroaryloxy, substituted heteroaryloxy, heterocyclyloxy, substituted
heterocyclyloxy, oxycarbonylamino, oxythiocarbonylamino, -OS(O)₂-alkyl,
-OS(O)₂-substituted alkyl, -OS(O)₂-aryl, -OS(O)₂-substituted aryl, -OS(O)₂-
15 heteroaryl, -OS(O)₂-substituted heteroaryl, -OS(O)₂-heterocyclic, -OS(O)₂-
substituted heterocyclic, -OSO₂-NRR where R is hydrogen or alkyl, -NRS(O)₂-
alkyl, -NRS(O)₂-substituted alkyl, -NRS(O)₂-aryl, -NRS(O)₂-substituted aryl,
-NRS(O)₂-heteroaryl, -NRS(O)₂-substituted heteroaryl, -NRS(O)₂-heterocyclic,
-NRS(O)₂-substituted heterocyclic, -NRS(O)₂-NR-alkyl, -NRS(O)₂-NR-substituted
20 alkyl, -NRS(O)₂-NR-aryl, -NRS(O)₂-NR-substituted aryl, -NRS(O)₂-NR-
heteroaryl, -NRS(O)₂-NR-substituted heteroaryl, -NRS(O)₂-NR-heterocyclic,
-NRS(O)₂-NR-substituted heterocyclic where R is hydrogen or alkyl, mono- and
di-alkylamino, mono- and di-(substituted alkyl)amino, mono- and di-arylamino,
mono- and di-substituted arylamino, mono- and di-heteroarylamino, mono- and di-
25 substituted heteroarylamino, mono- and di-heterocyclic amino, mono- and di-
substituted heterocyclic amino, unsymmetric di-substituted amines having different
substituents selected from alkyl, substituted alkyl, aryl, substituted aryl,
heteroaryl, substituted heteroaryl, heterocyclic and substituted heterocyclic and

substituted alkynyl groups having amino groups blocked by conventional blocking groups such as Boc, Cbz, formyl, and the like or alkynyl/substituted alkynyl groups substituted with -SO₂-alkyl, -SO₂-substituted alkyl, -SO₂-alkenyl, -SO₂-substituted alkenyl, -SO₂-cycloalkyl, -SO₂-substituted cycloalkyl, -SO₂-aryl, -SO₂-substituted aryl, -SO₂-heteroaryl, -SO₂-substituted heteroaryl, -SO₂-hetero-cyclic, -SO₂-substituted heterocyclic and -SO₂NRR where R is hydrogen or alkyl.

"Amidino" refers to the group H₂NC(=NH)- and the term "alkylamidino" refers to compounds having 1 to 3 alkyl groups (e.g., alkylHNC(=NH)-).

"Thioamidino" refers to the group RSC(=NH)- where R is hydrogen or alkyl.

"Amino" refers to the group -NH₂.

"Substituted amino" refers to the group -NRR, where each R group is independently selected from the group consisting of hydrogen, alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, cycloalkyl, substituted cycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclic, substituted heterocyclic, -SO₂-alkyl, -SO₂-substituted alkyl, -SO₂-alkenyl, -SO₂-substituted alkenyl, -SO₂-cycloalkyl, -SO₂-substituted cycloalkyl, -SO₂-aryl, -SO₂-substituted aryl, -SO₂-heteroaryl, -SO₂-substituted heteroaryl, -SO₂-heterocyclic, -SO₂-substituted heterocyclic, provided that both R groups are not hydrogen; or the R groups can be joined together with the nitrogen atom to form a heterocyclic or substituted heterocyclic ring.

"Aminoacyl" refers to the groups -NRC(O)alkyl, -NRC(O)substituted alkyl, -NRC(O)cycloalkyl, -NRC(O)substituted cycloalkyl, -NRC(O)alkenyl, -NRC(O)substituted alkenyl, -NRC(O)alkynyl, -NRC(O)substituted alkynyl, -NRC(O)aryl, -NRC(O)substituted aryl, -NRC(O)heteroaryl, -NRC(O)substituted heteroaryl, -NRC(O)heterocyclic, and -NRC(O)substituted heterocyclic where R is hydrogen or alkyl and wherein alkyl, substituted alkyl, alkenyl, substituted

alkenyl, alkynyl, substituted alkynyl, cycloalkyl, substituted cycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclic and substituted heterocyclic are as defined herein.

"Aminosulfonyl" refers to the groups -NRSO₂alkyl, -NRSO₂substituted alkyl, -NRSO₂cycloalkyl, -NRSO₂substituted cycloalkyl, -NRSO₂alkenyl, -NRSO₂substituted alkenyl, -NRSO₂alkynyl, -NRSO₂substituted alkynyl, -NRSO₂aryl, -NRSO₂substituted aryl, -NRSO₂heteroaryl, -NRSO₂substituted heteroaryl, -NRSO₂heterocyclic, and -NRSO₂substituted heterocyclic where R is hydrogen or alkyl and wherein alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, cycloalkyl, substituted cycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclic and substituted heterocyclic are as defined herein.

"Aminocarbonyloxy" refers to the groups -NRC(O)O-alkyl, -NRC(O)O-substituted alkyl, -NRC(O)O-alkenyl, -NRC(O)O-substituted alkenyl, -NRC(O)O-alkynyl, -NRC(O)O-substituted alkynyl, -NRC(O)O-cycloalkyl, -NRC(O)O-substituted cycloalkyl, -NRC(O)O-aryl, -NRC(O)O-substituted aryl, -NRC(O)O-heteroaryl, -NRC(O)O-substituted heteroaryl, -NRC(O)O-heterocyclic, and -NRC(O)O-substituted heterocyclic where R is hydrogen or alkyl and wherein alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, cycloalkyl, substituted cycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclic and substituted heterocyclic are as defined herein.

"Aminosulfonyloxy" refers to the groups -NRSO₂O-alkyl, -NRSO₂O-substituted alkyl, -NRSO₂O-alkenyl, -NRSO₂O-substituted alkenyl, -NRSO₂O-alkynyl, -NRSO₂O-substituted alkynyl, -NRSO₂O-cycloalkyl, -NRSO₂O-substituted cycloalkyl, -NRSO₂O-aryl, -NRSO₂O-substituted aryl, -NRSO₂O-heteroaryl, -NRSO₂O-substituted heteroaryl, -NRSO₂O-heterocyclic, and -NRSO₂O-substituted heterocyclic where R is hydrogen or alkyl and wherein alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, cycloalkyl, substituted

cycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclic and substituted heterocyclic are as defined herein.

"Oxycarbonylamino" refers to the groups -OC(O)NH₂, -OC(O)NRR, -OC(O)NR-alkyl, -OC(O)NR-substituted alkyl, -OC(O)NR-alkenyl, -OC(O)NR-substituted alkenyl, -OC(O)NR-alkynyl, -OC(O)NR-substituted alkynyl, -OC(O)NR-cycloalkyl, -OC(O)NR-substituted cycloalkyl, -OC(O)NR-aryl, -OC(O)NR-substituted aryl, -OC(O)NR-heteroaryl, -OC(O)NR-substituted heteroaryl, -OC(O)NR-heterocyclic, and -OC(O)NR-substituted heterocyclic where R is hydrogen, alkyl or where each R is joined to form, together with the nitrogen atom a heterocyclic or substituted heterocyclic ring and wherein alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, cycloalkyl, substituted cycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclic and substituted heterocyclic are as defined herein.

"Oxythiocarbonylamino" refers to the groups -OC(S)NH₂, -OC(S)NRR, -OC(S)NR-alkyl, -OC(S)NR-substituted alkyl, -OC(S)NR-alkenyl, -OC(S)NR-substituted alkenyl, -OC(S)NR-alkynyl, -OC(S)NR-substituted alkynyl, -OC(S)NR-cycloalkyl, -OC(S)NR-substituted cycloalkyl, -OC(S)NR-aryl, -OC(S)NR-substituted aryl, -OC(S)NR-heteroaryl, -OC(S)NR-substituted heteroaryl, -OC(S)NR-heterocyclic, and -OC(S)NR-substituted heterocyclic where R is hydrogen, alkyl or where each R is joined to form together with the nitrogen atom a heterocyclic or substituted heterocyclic ring and wherein alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, cycloalkyl, substituted cycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclic and substituted heterocyclic are as defined herein.

"Oxysulfonylamino" refers to the groups -OSO₂NH₂, -OSO₂NRR, -OSO₂NR-alkyl, -OSO₂NR-substituted alkyl, -OSO₂NR-alkenyl, -OSO₂NR-substituted alkenyl, -OSO₂NR-alkynyl, -OSO₂NR-substituted alkynyl, -OSO₂NR-

cycloalkyl, -OSO₂NR-substituted cycloalkyl, -OSO₂NR-aryl, -OSO₂NR-substituted aryl, -OSO₂NR-heteroaryl, -OSO₂NR-substituted heteroaryl, -OSO₂NR-heterocyclic, and -OSO₂NR-substituted heterocyclic where R is hydrogen, alkyl or where each R is joined to form, together with the nitrogen atom a heterocyclic or substituted heterocyclic ring and wherein alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, cycloalkyl, substituted cycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclic and substituted heterocyclic are as defined herein.

"Aminocarbonylamino" refers to the groups -NRC(O)NRR, -NRC(O)NR-alkyl, -NRC(O)NR-substituted alkyl, -NRC(O)NR-alkenyl, -NRC(O)NR-substituted alkenyl, -NRC(O)NR-alkynyl, -NRC(O)NR-substituted alkynyl, -NRC(O)NR-aryl, -NRC(O)NR-substituted aryl, -NRC(O)NR-cycloalkyl, -NRC(O)NR-substituted cycloalkyl, -NRC(O)NR-heteroaryl, and -NRC(O)NR-substituted heteroaryl, -NRC(O)NR-heterocyclic, and -NRC(O)NR-substituted heterocyclic where each R is independently hydrogen, alkyl or where each R is joined to form together with the nitrogen atom a heterocyclic or substituted heterocyclic ring as well as where one of the amino groups is blocked by conventional blocking groups such as Boc, Cbz, formyl, and the like and wherein alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, cycloalkyl, substituted cycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclic and substituted heterocyclic are as defined herein.

"Aminothiocabonylamino" refers to the groups -NRC(S)NRR, -NRC(S)NR-alkyl, -NRC(S)NR-substituted alkyl, -NRC(S)NR-alkenyl, -NRC(S)NR-substituted alkenyl, -NRC(S)NR-alkynyl, -NRC(S)NR-substituted alkynyl, -NRC(S)NR-aryl, -NRC(S)NR-substituted aryl, -NRC(S)NR-cycloalkyl, -NRC(S)NR-substituted cycloalkyl, -NRC(S)NR-heteroaryl, and -NRC(S)NR-substituted heteroaryl, -NRC(S)NR-heterocyclic, and -NRC(S)NR-substituted heterocyclic where each R is independently hydrogen, alkyl or where each R is

joined to form together with the nitrogen atom a heterocyclic or substituted heterocyclic ring as well as where one of the amino groups is blocked by conventional blocking groups such as Boc, Cbz, formyl, and the like and wherein alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, cycloalkyl, substituted cycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclic and substituted heterocyclic are as defined herein.

"Aminosulfonylamino" refers to the groups -NRSO₂NRR, -NRSO₂NR-alkyl, -NRSO₂NR-substituted alkyl, -NRSO₂NR-alkenyl, -NRSO₂NR-substituted alkenyl, -NRSO₂NR-alkynyl, -NRSO₂NR-substituted alkynyl, -NRSO₂NR-aryl, -NRSO₂NR-substituted aryl, -NRSO₂NR-cycloalkyl, -NRSO₂NR-substituted cycloalkyl, -NRSO₂NR-heteroaryl, and -NRSO₂NR-substituted heteroaryl, -NRSO₂NR-heterocyclic, and -NRSO₂NR-substituted heterocyclic, where each R is independently hydrogen, alkyl or where each R is joined to form together with the nitrogen atom a heterocyclic or substituted heterocyclic ring as well as where one of the amino groups is blocked by conventional blocking groups such as Boc, Cbz, formyl, and the like and wherein alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, cycloalkyl, substituted cycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclic and substituted heterocyclic are as defined herein.

"Aryl" or "Ar" refers to an unsaturated aromatic carbocyclic group of from 6 to 14 carbon atoms having a single ring (e.g., phenyl) or multiple condensed rings (e.g., naphthyl or anthryl) which condensed rings may or may not be aromatic (e.g., 2-benzoxazolinone, 2H-1,4-benzoxazin-3(4H)-one-7yl, and the like). Preferred aryls include phenyl and naphthyl.

Substituted aryl refers to aryl groups which are substituted with from 1 to 3 substituents selected from the group consisting of hydroxy, acyl, acylamino, thiocarbonylamino, acyloxy, alkyl, substituted alkyl, alkoxy, substituted alkoxy, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, amidino, alkylamidino,

thioamidino, amino, aminoacyl, aminocarbonyloxy, aminocarbonylamino, aminothiocabonylamino, aryl, substituted aryl, aryloxy, substituted aryloxy, cycloalkoxy, substituted cycloalkoxy, heteroaryloxy, substituted heteroaryloxy, heterocyclyloxy, substituted heterocyclyloxy, carboxyl, carboxylalkyl, carboxyl-substituted alkyl, carboxyl-cycloalkyl, carboxyl-substituted cycloalkyl, carboxylaryl, carboxyl-substituted aryl, carboxylheteroaryl, carboxyl-substituted heteroaryl, carboxylheterocyclic, carboxyl-substituted heterocyclic, carboxylamido, cyano, thiol, thioalkyl, substituted thioalkyl, thioaryl, substituted thioaryl, thioheteroaryl, substituted thioheteroaryl, thiocycloalkyl, substituted thiocycloalkyl, thioheterocyclic, substituted thioheterocyclic, cycloalkyl, substituted cycloalkyl, guanidino, guanidinosulfone, halo, nitro, heteroaryl, substituted heteroaryl, heterocyclic, substituted heterocyclic, cycloalkoxy, substituted cycloalkoxy, heteroaryloxy, substituted heteroaryloxy, heterocyclyloxy, substituted heterocyclyloxy, oxycarbonylamino, oxythiocarbonylamino, -S(O)₂-alkyl, -S(O)₂-substituted alkyl, -S(O)₂-cycloalkyl, -S(O)₂-substituted cycloalkyl, -S(O)₂-alkenyl, -S(O)₂-substituted alkenyl, -S(O)₂-aryl, -S(O)₂-substituted aryl, -S(O)₂-heteroaryl, -S(O)₂-substituted heteroaryl, -S(O)₂-heterocyclic, -S(O)₂-substituted heterocyclic, -OS(O)₂-alkyl, -OS(O)₂-substituted alkyl, -OS(O)₂-aryl, -OS(O)₂-substituted aryl, -OS(O)₂-heteroaryl, -OS(O)₂-substituted heteroaryl, -OS(O)₂-heterocyclic, -OS(O)₂-substituted heterocyclic, -OSO₂-NRR where R is hydrogen or alkyl, -NRS(O)₂-alkyl, -NRS(O)₂-substituted alkyl, -NRS(O)₂-aryl, -NRS(O)₂-substituted aryl, -NRS(O)₂-heteroaryl, -NRS(O)₂-substituted heteroaryl, -NRS(O)₂-heterocyclic, -NRS(O)₂-substituted heterocyclic, -NRS(O)₂-NR-alkyl, -NRS(O)₂-NR-substituted alkyl, -NRS(O)₂-NR-aryl, -NRS(O)₂-NR-substituted aryl, -NRS(O)₂-NR-heteroaryl, -NRS(O)₂-NR-substituted heteroaryl, -NRS(O)₂-NR-heterocyclic, -NRS(O)₂-NR-substituted heterocyclic where R is hydrogen or alkyl, mono- and di-alkylamino, mono- and di-(substituted alkyl)amino, mono- and di-arylamino, mono- and di-

substituted arylamino, mono- and di-heteroarylamino, mono- and di-substituted heteroarylamino, mono- and di-heterocyclic amino, mono- and di-substituted heterocyclic amino, unsymmetric di-substituted amines having different substituents selected from alkyl, substituted alkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclic and substituted heterocyclic and amino groups on the substituted aryl blocked by conventional blocking groups such as Boc, Cbz, formyl, and the like or substituted with $-SO_2NRR$ where R is hydrogen or alkyl.

"Aryloxy" refers to the group aryl-O- which includes, by way of example, phenoxy, naphthoxy, and the like.

"Substituted aryloxy" refers to substituted aryl-O- groups.

"Aryloxyaryl" refers to the group -aryl-O-aryl.

"Substituted aryloxyaryl" refers to aryloxyaryl groups substituted with from 1 to 3 substituents on either or both aryl rings selected from the group consisting of hydroxy, acyl, acylamino, thiocarbonylamino, acyloxy, alkyl, substituted alkyl, alkoxy, substituted alkoxy, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, amidino, alkylamidino, thioamidino, amino, aminoacyl, aminocarbonyloxy, aminocarbonylamino, aminothiocabonylamino, aryl, substituted aryl, aryloxy, substituted aryloxy, cycloalkoxy, substituted cycloalkoxy, heteroaryloxy, substituted heteroaryloxy, heterocyclyloxy, substituted heterocyclyloxy, carboxyl, carboxylalkyl, carboxyl-substituted alkyl, carboxyl-cycloalkyl, carboxyl-substituted cycloalkyl, carboxylaryl, carboxyl-substituted aryl, carboxylheteroaryl, carboxyl-substituted heteroaryl, carboxylheterocyclic, carboxyl-substituted heterocyclic, carboxylamido, cyano, thiol, thioalkyl, substituted thioalkyl, thioaryl, substituted thioaryl, thioheteroaryl, substituted thioheteroaryl, thiocycloalkyl, substituted thiocycloalkyl, thioheterocyclic, substituted thioheterocyclic, cycloalkyl, substituted cycloalkyl, guanidino, guanidinosulfone, halo, nitro, heteroaryl, substituted heteroaryl,

heterocyclic, substituted heterocyclic, cycloalkoxy, substituted cycloalkoxy,
heteroaryloxy, substituted heteroaryloxy, heterocyclyloxy, substituted
heterocyclyloxy, oxycarbonylamino, oxythiocarbonylamino, -S(O)₂-alkyl, -S(O)₂-
substituted alkyl, -S(O)₂-cycloalkyl, -S(O)₂-substituted cycloalkyl, -S(O)₂-alkenyl,
5 -S(O)₂-substituted alkenyl, -S(O)₂-aryl, -S(O)₂-substituted aryl, -S(O)₂-heteroaryl,
-S(O)₂-substituted heteroaryl, -S(O)₂-heterocyclic, -S(O)₂-substituted heterocyclic, -
OS(O)₂-alkyl, -OS(O)₂-substituted alkyl, -OS(O)₂-aryl, -OS(O)₂-substituted aryl,
-OS(O)₂-heteroaryl, -OS(O)₂-substituted heteroaryl, -OS(O)₂-heterocyclic, -OS(O)₂-
substituted heterocyclic, -OSO₂-NRR where R is hydrogen or alkyl, -NRS(O)₂-
10 alkyl, -NRS(O)₂-substituted alkyl, -NRS(O)₂-aryl, -NRS(O)₂-substituted aryl, -
NRS(O)₂-heteroaryl, -NRS(O)₂-substituted heteroaryl, -NRS(O)₂-heterocyclic, -
NRS(O)₂-substituted heterocyclic, -NRS(O)₂-NR-alkyl, -NRS(O)₂-NR-substituted
alkyl, -NRS(O)₂-NR-aryl, -NRS(O)₂-NR-substituted aryl, -NRS(O)₂-NR-
heteroaryl, -NRS(O)₂-NR-substituted heteroaryl, -NRS(O)₂-NR-heterocyclic, -
15 NRS(O)₂-NR-substituted heterocyclic where R is hydrogen or alkyl, mono- and di-
alkylamino, mono- and di-(substituted alkyl)amino, mono- and di-arylamino,
mono- and di-substituted arylamino, mono- and di-heteroarylamino, mono- and di-
substituted heteroarylamino, mono- and di-heterocyclic amino, mono- and di-
substituted heterocyclic amino, unsymmetric di-substituted amines having different
20 substituents selected from alkyl, substituted alkyl, aryl, substituted aryl,
heteroaryl, substituted heteroaryl, heterocyclic and substituted heterocyclic and
amino groups on the substituted aryl blocked by conventional blocking groups such
as Boc, Cbz, formyl, and the like or substituted with -SO₂NRR where R is
hydrogen or alkyl.

25 "Cycloalkyl" refers to cyclic alkyl groups of from 3 to 8 carbon atoms
having a single cyclic ring including, by way of example, cyclopropyl, cyclobutyl,
cyclopentyl, cyclohexyl, cyclooctyl and the like. Excluded from this definition are
multi-ring alkyl groups such as adamantanyl, etc.

"Cycloalkenyl" refers to cyclic alkenyl groups of from 3 to 8 carbon atoms having single or multiple unsaturation but which are not aromatic.

"Substituted cycloalkyl" and "substituted cycloalkenyl" refer to a cycloalkyl and cycloalkenyl groups, preferably of from 3 to 8 carbon atoms, having from 1 to 5 substituents selected from the group consisting of oxo (=O), thioxo (=S), alkoxy, substituted alkoxy, acyl, acylamino, thiocarbonylamino, acyloxy, amino, amidino, alkylamidino, thioamidino, aminoacyl, aminocarbonylamino, aminothiocabonylamino, aminocarbonyloxy, aryl, substituted aryl, aryloxy, substituted aryloxy, aryloxyaryl, substituted aryloxyaryl, halogen, hydroxyl, cyano, nitro, carboxyl, carboxylalkyl, carboxyl-substituted alkyl, carboxyl-cycloalkyl, carboxyl-substituted cycloalkyl, carboxylaryl, carboxyl-substituted aryl, carboxylheteroaryl, carboxyl-substituted heteroaryl, carboxylheterocyclic, carboxyl-substituted heterocyclic, cycloalkyl, substituted cycloalkyl, guanidino, guanidinosulfone, thiol, thioalkyl, substituted thioalkyl, thioaryl, substituted thioaryl, thiocycloalkyl, substituted thiocycloalkyl, thioheteroaryl, substituted thioheteroaryl, thioheterocyclic, substituted thioheterocyclic, heteroaryl, substituted heteroaryl, heterocyclic, substituted heterocyclic, cycloalkoxy, substituted cycloalkoxy, heteroaryloxy, substituted heteroaryloxy, heterocyclyloxy, substituted heterocyclyloxy, oxycarbonylamino, oxythiocarbonylamino, -OS(O)₂-alkyl, -OS(O)₂-substituted alkyl, -OS(O)₂-aryl, -OS(O)₂-substituted aryl, -OS(O)₂-heteroaryl, -OS(O)₂-substituted heteroaryl, -OS(O)₂-heterocyclic, -OS(O)₂-substituted heterocyclic, -OSO₂-NRR where R is hydrogen or alkyl, -NRS(O)₂-alkyl, -NRS(O)₂-substituted alkyl, -NRS(O)₂-aryl, -NRS(O)₂-substituted aryl, -NRS(O)₂-heteroaryl, -NRS(O)₂-substituted heteroaryl, -NRS(O)₂-heterocyclic, -NRS(O)₂-substituted heterocyclic, -NRS(O)₂-NR-alkyl, -NRS(O)₂-NR-substituted alkyl, -NRS(O)₂-NR-aryl, -NRS(O)₂-NR-substituted aryl, -NRS(O)₂-NR-heteroaryl, -NRS(O)₂-NR-substituted heteroaryl, -NRS(O)₂-NR-heterocyclic, -NRS(O)₂-NR-substituted heterocyclic where R is hydrogen or

alkyl, mono- and di-alkylamino, mono- and di-(substituted alkyl)amino, mono- and di-arylamino, mono- and di-substituted arylamino, mono- and di-heteroarylamino, mono- and di-substituted heteroarylamino, mono- and di-heterocyclic amino, mono- and di-substituted heterocyclic amino, unsymmetric di-substituted amines having different substituents selected from alkyl, substituted alkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclic and substituted heterocyclic and substituted alkynyl groups having amino groups blocked by conventional blocking groups such as Boc, Cbz, formyl, and the like or alkynyl/substituted alkynyl groups substituted with -SO₂-alkyl, -SO₂-substituted alkyl, -SO₂-alkenyl, -SO₂-substituted alkenyl, -SO₂-cycloalkyl, -SO₂-substituted cycloalkyl, -SO₂-aryl, -SO₂-substituted aryl, -SO₂-heteroaryl, -SO₂-substituted heteroaryl, -SO₂-heterocyclic, -SO₂-substituted heterocyclic and -SO₂NRR where R is hydrogen or alkyl.

"Cycloalkoxy" refers to -O-cycloalkyl groups.

"Substituted cycloalkoxy" refers to -O-substituted cycloalkyl groups.

"Cycloalkenoxy" refers to -O-cycloalkenyl groups.

"Substituted cycloalkenoxy" refers to -O-substituted cycloalkenyl groups.

"Guanidino" refers to the groups -NRC(=NR)NRR, -NRC(=NR)NR-alkyl, -NRC(=NR)NR-substituted alkyl, -NRC(=NR)NR-alkenyl, -NRC(=NR)NR-substituted alkenyl, -NRC(=NR)NR-alkynyl, -NRC(=NR)NR-substituted alkynyl, -NRC(=NR)NR-aryl, -NRC(=NR)NR-substituted aryl, -NRC(=NR)NR-cycloalkyl, -NRC(=NR)NR-heteroaryl, -NRC(=NR)NR-substituted heteroaryl, -NRC(=NR)NR-heterocyclic, and -NRC(=NR)NR-substituted heterocyclic where each R is independently hydrogen and alkyl as well as where one of the amino groups is blocked by conventional blocking groups such as Boc, Cbz, formyl, and the like and wherein alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, cycloalkyl, substituted cycloalkyl,

aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclic and substituted heterocyclic are as defined herein.

"Guanidinosulfone" refers to the groups -NRC(=NR)NRSO₂-alkyl, -NRC(=NR)NRSO₂-substituted alkyl, -NRC(=NR)NRSO₂-alkenyl, -NRC(=NR)NRSO₂-substituted alkenyl, -NRC(=NR)NRSO₂-alkynyl, -NRC(=NR)NRSO₂-substituted alkynyl, -NRC(=NR)NRSO₂-aryl, -NRC(=NR)NRSO₂-substituted aryl, -NRC(=NR)NRSO₂-cycloalkyl, -NRC(=NR)NRSO₂-substituted cycloalkyl, -NRC(=NR)NRSO₂-heteroaryl, and -NRC(=NR)NRSO₂-substituted heteroaryl, -NRC(=NR)NRSO₂-heterocyclic, and -NRC(=NR)NRSO₂-substituted heterocyclic where each R is independently hydrogen and alkyl and wherein alkyl, substituted alkyl, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, cycloalkyl, substituted cycloalkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclic and substituted heterocyclic are as defined herein.

"Halo" or "halogen" refers to fluoro, chloro, bromo and iodo and preferably is either chloro or bromo.

"Heteroaryl" refers to an aromatic carbocyclic group of from 2 to 10 carbon atoms and 1 to 4 heteroatoms selected from oxygen, nitrogen and sulfur within the ring or oxides thereof. Such heteroaryl groups can have a single ring (e.g., pyridyl or furyl) or multiple condensed rings (e.g., indolizinyl or benzothienyl). Additionally, the heteroatoms of the heteroaryl group may be oxidized, i.e., to form pyridine N-oxides or 1,1-dioxo-1,2,5-thiadiazoles and the like. Preferred heteroaryls include pyridyl, pyrrolyl, indolyl, furyl, pyridazinyl, pyrimidinyl, pyrazinyl, 1-oxo-1,2,5-thiadiazolyl and 1,1-dioxo-1,2,5-thiadiazolyl. The term "heteroaryl having two nitrogen atoms in the heteroaryl ring" refers to a heteroaryl group having two, and only two, nitrogen atoms in the heteroaryl ring and optionally containing 1 or 2 other heteroatoms in the heteroaryl ring, such as oxygen or sulfur

"Substituted heteroaryl" refers to heteroaryl groups which are substituted with from 1 to 3 substituents selected from the group consisting of hydroxy, acyl, acylamino, thiocarbonylamino, acyloxy, alkyl, substituted alkyl, alkoxy, substituted alkoxy, alkenyl, substituted alkenyl, alkynyl, substituted alkynyl, amidino, alkylamidino, thioamidino, amino, aminoacyl, aminocarbonyloxy, aminocarbonylamino, aminothiocarbonylamino, aryl, substituted aryl, aryloxy, substituted aryloxy, cycloalkoxy, substituted cycloalkoxy, heteroaryloxy, substituted heteroaryloxy, heterocyclyloxy, substituted heterocyclyloxy, carboxyl, carboxylalkyl, carboxyl-substituted alkyl, carboxyl-cycloalkyl, carboxyl-substituted cycloalkyl, carboxylaryl, carboxyl-substituted aryl, carboxylheteroaryl, carboxyl-substituted heteroaryl, carboxylheterocyclic, carboxyl-substituted heterocyclic, carboxylamido, cyano, thiol, thioalkyl, substituted thioalkyl, thioaryl, substituted thioaryl, thioheteroaryl, substituted thioheteroaryl, thiocycloalkyl, substituted thiocycloalkyl, thioheterocyclic, substituted thioheterocyclic, cycloalkyl, substituted cycloalkyl, guanidino, guanidinosulfone, halo, nitro, heteroaryl, substituted heteroaryl, heterocyclic, substituted heterocyclic, cycloalkoxy, substituted cycloalkoxy, heteroaryloxy, substituted heteroaryloxy, heterocyclyloxy, substituted heterocyclyloxy, oxycarbonylamino, oxythiocarbonylamino, -S(O)₂-alkyl, -S(O)₂-substituted alkyl, -S(O)₂-cycloalkyl, -S(O)₂-substituted cycloalkyl, -S(O)₂-alkenyl, -S(O)₂-substituted alkenyl, -S(O)₂-aryl, -S(O)₂-substituted aryl, -S(O)₂-heteroaryl, -S(O)₂-substituted heteroaryl, -S(O)₂-heterocyclic, -S(O)₂-substituted heterocyclic, -OS(O)₂-alkyl, -OS(O)₂-substituted alkyl, -OS(O)₂-aryl, -OS(O)₂-substituted aryl, -OS(O)₂-heteroaryl, -OS(O)₂-substituted heteroaryl, -OS(O)₂-heterocyclic, -OS(O)₂-substituted heterocyclic, -OSO₂-NRR where R is hydrogen or alkyl, -NRS(O)₂-alkyl, -NRS(O)₂-substituted alkyl, -NRS(O)₂-aryl, -NRS(O)₂-substituted aryl, -NRS(O)₂-heteroaryl, -NRS(O)₂-substituted heteroaryl, -NRS(O)₂-heterocyclic, -NRS(O)₂-substituted heterocyclic, -NRS(O)₂-NR-alkyl, -NRS(O)₂-NR-substituted alkyl,

-NRS(O)₂-NR-aryl, -NRS(O)₂-NR-substituted aryl, -NRS(O)₂-NR-heteroaryl,
-NRS(O)₂-NR-substituted heteroaryl, -NRS(O)₂-NR-heterocyclic, -NRS(O)₂-NR-
substituted heterocyclic where R is hydrogen or alkyl, mono- and di-alkylamino,
mono- and di-(substituted alkyl)amino, mono- and di-arylamino, mono- and di-
5 substituted arylamino, mono- and di-heteroarylamino, mono- and di-substituted
heteroarylamino, mono- and di-heterocyclic amino, mono- and di-substituted
heterocyclic amino, unsymmetric di-substituted amines having different
substituents selected from alkyl, substituted alkyl, aryl, substituted aryl,
heteroaryl, substituted heteroaryl, heterocyclic and substituted heterocyclic and
10 amino groups on the substituted aryl blocked by conventional blocking groups such
as Boc, Cbz, formyl, and the like or substituted with -SO₂NRR where R is
hydrogen or alkyl.

"Heteroaryloxy" refers to the group -O-heteroaryl and "substituted
heteroaryloxy" refers to the group -O-substituted heteroaryl.

15 "Heterocycle" or "heterocyclic" refers to a saturated or unsaturated
group having a single ring or multiple condensed rings, from 1 to 10 carbon atoms
and from 1 to 4 hetero atoms selected from nitrogen, sulfur or oxygen within the
ring wherein, in fused ring systems, one or more of the rings can be aryl or
heteroaryl.

20 "Substituted heterocyclic" refers to heterocycle groups which are
substituted with from 1 to 3 substituents selected from the group consisting of oxo
(=O), thioxo (=S), alkoxy, substituted alkoxy, acyl, acylamino,
thiocarbonylamino, acyloxy, amino, amidino, alkylamidino, thioamidino,
aminoacyl, aminocarbonylamino, aminothiocarbonylamino, aminocarbonyloxy,
25 aryl, substituted aryl, aryloxy, substituted aryloxy, aryloxyaryl, substituted
aryloxyaryl, halogen, hydroxyl, cyano, nitro, carboxyl, carboxylalkyl, carboxyl-
substituted alkyl, carboxyl-cycloalkyl, carboxyl-substituted cycloalkyl,
carboxylaryl, carboxyl-substituted aryl, carboxylheteroaryl, carboxyl-substituted

heteroaryl, carboxylheterocyclic, carboxyl-substituted heterocyclic, cycloalkyl, substituted cycloalkyl, guanidino, guanidinosulfone, thiol, thioalkyl, substituted thioalkyl, thioaryl, substituted thioaryl, thiocycloalkyl, substituted thiocycloalkyl, thioheteroaryl, substituted thioheteroaryl, thioheterocyclic, substituted thioheterocyclic, heteroaryl, substituted heteroaryl, heterocyclic, substituted heterocyclic, cycloalkoxy, substituted cycloalkoxy, heteroaryloxy, substituted heteroaryloxy, heterocyclyloxy, substituted heterocyclyloxy, oxycarbonylamino, oxythiocarbonylamino, -OS(O)₂-alkyl, -OS(O)₂-substituted alkyl, -OS(O)₂-aryl, -OS(O)₂-substituted aryl, -OS(O)₂-heteroaryl, -OS(O)₂-substituted heteroaryl, -OS(O)₂-heterocyclic, -OS(O)₂-substituted heterocyclic, -OSO₂-NRR where R is hydrogen or alkyl, -NRS(O)₂-alkyl, -NRS(O)₂-substituted alkyl, -NRS(O)₂-aryl, -NRS(O)₂-substituted aryl, -NRS(O)₂-heteroaryl, -NRS(O)₂-substituted heteroaryl, -NRS(O)₂-heterocyclic, -NRS(O)₂-substituted heterocyclic, -NRS(O)₂-NR-alkyl, -NRS(O)₂-NR-substituted alkyl, -NRS(O)₂-NR-aryl, -NRS(O)₂-NR-substituted aryl, -NRS(O)₂-NR-heteroaryl, -NRS(O)₂-NR-substituted heteroaryl, -NRS(O)₂-NR-heterocyclic, -NRS(O)₂-NR-substituted heterocyclic where R is hydrogen or alkyl, mono- and di-alkylamino, mono- and di-(substituted alkyl)amino, mono- and di-arylamino, mono- and di-substituted arylamino, mono- and di-heteroarylamino, mono- and di-substituted heteroarylamino; mono- and di-heterocyclic amino, mono- and di-substituted heterocyclic amino, unsymmetric di-substituted amines having different substituents selected from alkyl, substituted alkyl, aryl, substituted aryl, heteroaryl, substituted heteroaryl, heterocyclic and substituted heterocyclic and substituted alkynyl groups having amino groups blocked by conventional blocking groups such as Boc, Cbz, formyl, and the like or alkynyl/substituted alkynyl groups substituted with -SO₂-alkyl, -SO₂-substituted alkyl, -SO₂-alkenyl, -SO₂-substituted alkenyl, -SO₂-cycloalkyl, -SO₂-substituted cycloalkyl, -SO₂-aryl, -SO₂-substituted aryl, -SO₂-heteroaryl, -SO₂-substituted heteroaryl, -SO₂-

heterocyclic, -SO₂-substituted heterocyclic and -SO₂NRR where R is hydrogen or alkyl.

Examples of heterocycles and heteroaryls include, but are not limited to, azetidine, pyrrole, imidazole, pyrazole, pyridine, pyrazine, pyrimidine, pyridazine, indolizine, isoindole, indole, dihydroindole, indazole, purine, quinolizine, isoquinoline, quinoline, phthalazine, naphthylpyridine, quinoxaline, quinazoline, cinnoline, pteridine, carbazole, carboline, phenanthridine, acridine, phenanthroline, isothiazole, phenazine, isoxazole, phenoxazine, phenothiazine, imidazolidine, imidazoline, piperidine, piperazine, indoline, phthalimide, 1,2,3,4-tetrahydroisoquinoline, 4,5,6,7-tetrahydrobenzo[b]thiophene, thiazole, thiazolidine, thiophene, benzo[b]thiophene, morpholino, thiomorpholino, piperidinyl, pyrrolidine, tetrahydrofuranyl, and the like.

"Heterocyclyloxy" refers to the group -O-heterocyclic and "substituted heterocyclyloxy" refers to the group -O-substituted heterocyclic.

"Thiol" refers to the group -SH.

"Thioalkyl" refers to the groups -S-alkyl

"Substituted thioalkyl" refers to the group -S-substituted alkyl.

"Thiocycloalkyl" refers to the groups -S-cycloalkyl.

"Substituted thiocycloalkyl" refers to the group -S-substituted cycloalkyl.

"Thioaryl" refers to the group -S-aryl and "substituted thioaryl" refers to the group -S-substituted aryl.

"Thioheteroaryl" refers to the group -S-heteroaryl and "substituted thioheteroaryl" refers to the group -S-substituted heteroaryl.

"Thioheterocyclic" refers to the group -S-heterocyclic and "substituted thioheterocyclic" refers to the group -S-substituted heterocyclic.

"Pharmaceutically acceptable salt" refers to pharmaceutically acceptable salts of a compound of Formula I which salts are derived from a variety of organic and inorganic counter ions well known in the art and include, by way of example

only, sodium, potassium, calcium, magnesium, ammonium, tetraalkylammonium, and the like; and when the molecule contains a basic functionality, salts of organic or inorganic acids, such as hydrochloride, hydrobromide, tartrate, mesylate, acetate, maleate, oxalate and the like.

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METHODOLOGY

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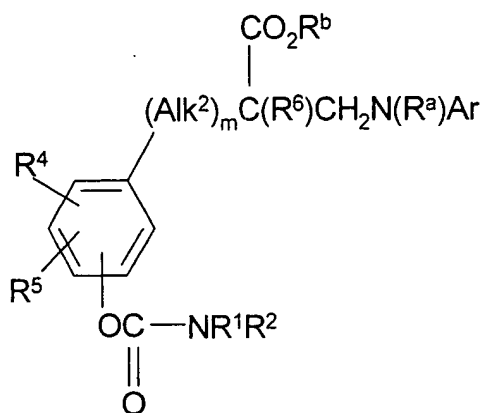
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The compounds of the invention may be prepared by a number of processes as generally described below and more specifically in the Examples hereinafter. In the following process description, the symbols R-R⁶ (including R^a), Ar, Alk², m and r, when used in the formulae depicted are to be understood to represent those groups described above in relation to formula (1) and formula (2) unless otherwise indicated. In the reactions described below, it may be necessary to protect reactive functional groups, for example hydroxy, amino, thio or carboxy groups, where these are desired in the final product, to avoid their unwanted participation in the reactions. Conventional protecting groups may be used in accordance with standard practice [see, for example, Green, T. W. in "Protective Groups in Organic Synthesis", John Wiley and Sons, 1991]. In some instances, deprotection may be the final step in the synthesis of a compound of formula (1) and the processes according to the invention described hereinafter are to be understood to extend to such removal of protecting groups. For convenience the processes described below all refer to a preparation of a compound of formula (1) but clearly the description applies equally to the preparation of compounds of formula (2).

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Thus according to a further aspect of the invention, a compound of formula (1) in which R is a -CO₂H group may be obtained by hydrolysis of an ester of formula (3):

-46-



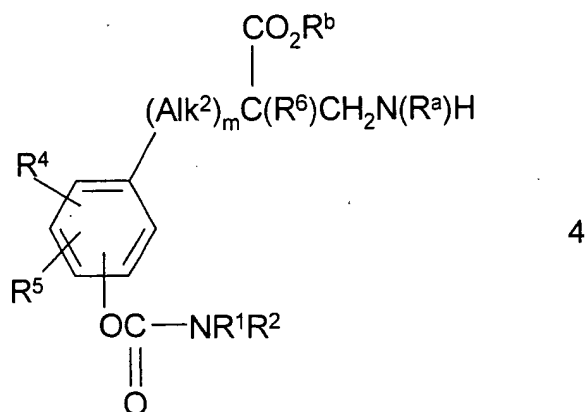
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where R^b is an alkyl group, for example a C_{1-6} alkyl group as described above.

The hydrolysis may be performed using either an acid or a base depending on the nature of R^b , for example an organic acid such as trifluoroacetic acid or an inorganic base such as lithium or potassium hydroxide optionally in an aqueous organic solvent such as an amide, e.g., a substituted amide such as dimethylformamide, an ether, e.g. a cyclic ether such as tetrahydrofuran or dioxane or an alcohol, e.g. methanol at around ambient temperature. Where desired, mixtures of such solvents may be used.

Esters of formula (3) may be prepared by coupling an amine of formula (4):

-47-



or a salt thereof with a reagent Ar-X^1 where X^1 is a leaving group. Particular leaving groups represented by X^1 include for example halogen atoms such as fluorine, chlorine or bromine atoms or sulphonyloxy groups such as a methylsulphonyloxy group.

The coupling reaction may be performed using standard conditions for reactions of this type. Thus for example the reaction may be carried out in a solvent, for example an alcohol, e.g. methanol or ethanol, at a temperature from around ambient to the reflux temperature, optionally in the presence of a base, e.g. an organic base such as an amine, e.g. triethylamine or N,N-diisopropylethylamine, or a cyclic amine, such as N-methylmorpholine or pyridine.

Where desired, compounds of formula (4) may be linked to a suitable solid support, for example via their carboxylate group (R^b is H), and subsequently converted to compounds of formula (1) linked to the solid support via the methods just described. Displacement from the resin by any convenient method for example by cleavage using an acid such as trifluoroacetic acid, then gives the

desired compound of formula (1). Particular examples of such solid-phase syntheses are given in the Examples herein.

The amines of formula (4) may be obtained from simpler, known compounds by one or more standard synthetic methods employing C-C bond formation substitution, 1,4-addition, oxidation, reduction or cleavage reactions. Particular C-C bond forming reactions include the HornerEmmons and Wittig reactions. Particular substitution approaches include conventional alkylation, arylation, heteroarylation, acylation, thioacylation, halogenation, sulphonylation, nitration, formylation and coupling procedures. It will be appreciated that these methods may also be used to obtain or modify other compounds of formulae (1) and (2) where appropriate functional groups exist in these compounds. Additionally, although a number of the intermediates ArX^1 for use in the coupling reaction described above are known, others can be derived therefrom using these standard synthetic methods.

Thus compounds of the invention and intermediates thereto may be prepared by alkylation, arylation or heteroarylation. For example, compounds of formula II can be prepared from the phenolic intermediate by reaction with, for example, 4-nitrophenyl chloroformate followed by reaction with an amine of the formula



where R^1 and R^2 are as defined above. Further examples of this reaction are set forth in U.S. Patent Application Serial No. 09/489,377 and WO 00/18759 both of which are incorporated herein by reference in its entirety.

Salts of compounds of formula (1) and (2) may be prepared by reaction of a compound of formula (1) or (2) with an appropriate base in a suitable solvent or mixture of solvents e.g. an organic solvent such as an ether e.g. diethylether, or an alcohol, e.g. ethanol using conventional procedures.

Where it is desired to obtain a particular enantiomer of a compound of formula (1) this may be produced from a corresponding mixture of enantiomers using any suitable conventional procedure for resolving enantiomers.

Thus for example diastereomeric derivatives, e.g. salts, may be produced by reaction of a mixture of enantiomers of formula (1) e.g. a racemate, and an appropriate chiral compound, e.g. a chiral base. The diastereomers may then be separated by any convenient means, for example by crystallization and the desired enantiomer recovered, e.g. by treatment with an acid in the instance where the diastereomer is a salt. In another resolution process a racemate of formula (1) may be separated using chiral High Performance Liquid Chromatography. Alternatively, if desired a particular enantiomer may be obtained by using an appropriate chiral intermediate in one of the processes described above.

Chromatography, recrystalliation and other conventional separation procedures may also be used with intermediates or final products where it is desired to obtain a particular geometric isomer of the invention.

The following Examples illustrate the invention. Examples 1-168 illustrate reaction schemes for use in preparing prior art compounds and Example 169 shows how such reaction schemes could be used to prepare compounds of this invention. All temperatures are in °C. The following abbreviations are used:

NMM - N-methylmorpholine;	EtOAc - ethyl acetate;
MeOH - methanol;	BOC - butoxycarbonyl;
DCM - dichloromethane;	AcOH - acetic acid;
DIPEA - N,N-diisopropylethyamine;	DMF - dimethylformamide;
LIDA - lithium N,N-diisopropylamide;	
mCPBA - 3-chloroperoxybenzoic acid	
All NMR's were obtained at 300mHz.	

INTERMEDIATE 1

3,5-Dichloropyridine-4-carboxylic acid

A solution of 3,5-dichloropyridine (5.00g, 33.8mmol) in THF (25ml) was added to a solution of LDA [generated from nBuLi (2.5M solution hexanes, 14.9ml, 37.2mmol) and diisopropylamine (4.108, 5.7ml, 40.6mmol)] in THF (25ml) at -78° then CO₂ gas was bubbled through to give a clear brown solution that slowly gave a precipitate, warmed to room temperature over 2h, then quenched with water (20ml) and partitioned between diethylether (100ml) and 1 M NaOH (100ml). The aqueous layer was separated and acidified to pH1 with concentrated hydrochloric acid and then extracted with 10% MeOH in DCM (100ml x 3). The combined organic layers were dried (MgSO₄) and the solvent removed *in vacuo* to give a brown solid that was recrystallised from ethanol and dried under vacuum to give the title compound as pinkish crystals (2.638, 41%): δ H (DMSO d₆) 8.72 (2H, s).

INTERMEDIATE 2

(S)-Ethyl-3-[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl]-2-(t-butoxycarbonylamino)propionate

A slurry of Intermediate 1 (51.2g, 0.267 mol) in DCM (195 ml) and thionyl chloride (195 ml, 2.67 mol) was treated with DMF (5 drops) and heated to reflux for 4h. The reaction was concentrated *in vacuo* and azeotroped with toluene (2 x 50 ml) to give the acid chloride derivative of intermediate 1 as a yellow solid which was used without further purification. A solution of (S)-ethyl-3-(4-aminophenyl)-2-(t-butoxycarbonylamino)propionate (130.8 g, 0.425 mol) in DCM (800 ml) was cooled to 0° and treated with NMM (56.0 ml, 0.51 mol), stirred 5 minutes and then a solution of the acid chloride (98.3g, 0.468 mol) in DCM (200 ml) was added dropwise keeping the reaction temperature below 5°. The reaction was stirred for 1h, quenched with NaHCO₃

solution (500 ml), the organic layer separated, washed with NaHCO₃ solution (500 ml), 10% citric acid solution (500 ml) and NaHCO₃ solution (500 ml), dried (MgSO₄) and concentrated *in vacuo* to give a yellow solid which was recrystallised (EtOAc/Hexane) to give the title compound (140 g, 69%): δ H (DMSO d₆) 8.80 (2H, s), 7.55 (2H, d, J 8.5Hz), 7.23 (2H, d, J 8.5Hz), 4.00 (3H, m), 3.40 (2H, br. s), 2.90 (1H, m), 2.80 (1H, m), 1.30 (9H, s), 1.25 (3H, t); m/z (EI⁺, 70V) 504.

INTERMEDIATE 3

(S)-Ethyl-3-[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl]-2-aminopropionate hydrochloride

A solution of Intermediate 2 (70.0g, 0.146 mol) in EtOAc (500 ml) and 1,4dioxan (50 ml) was treated with a solution of HCl in EtOAc (500 ml, 3M), and stirred at room temperature for 4h. The reaction was concentrated *in vacuo* to give a yellow solid which was triturated with Et₂O then recrystallised (EtOAc/hexane) to give the title compound (59.3 g, 92%): δ H (DMSO d₆) 11.10 (1H, s), 8.70 (2H, s), 7.55 (2H, d, J 8.4Hz), 7.25 (2H, d, J 8.4Hz), 4.10 (3H, m), 3.10 (2H, m), 1.10 (3H, m); m/z (EI⁺, 70V) 382.

INTERMEDIATE 4

(S)-Methyl-3-[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl]-2-aminopropionate hydrochloride

The title compound was prepared in a similar manner to Intermediate 3 starting from (S)-methyl-3-(4-aminophenyl)-2-(t-butoxycarbonylamino) propionate and Intermediate 1: δ H (DMSO d₆) 11.08 (1H, s), 8.77 (2H, s), 8.73 (3H, br. m), 7.63 (2H, d, J 8.5Hz), 7.25 (2H, d, J 8.5Hz), 4.24 (1H, m), 3.70 (3H, s), 3.16 (2H, m); m/z (EI⁺, 70V) 368 and 370.

INTERMEDIATE 5

3,5-Dichloro-4-hydroxymethylpyridine

A solution of 3,5-dichloropyridine-4-carboxaldehyde (1.34 g, 7.6 mmol) in MeOH (10 ml) was treated with NaBH₄ (0.29 g, 7.6 mmol) and stirred at room temperature for 2h. The reaction was quenched with water (5 ml) and concentrated *in vacuo*. The residue was partitioned between EtOAc (20 ml) and 10% HCl (10 ml). The aqueous layer was extracted with EtOAc and the combined organic extracts washed with 10% NaHCO₃ solution, dried (MgSO₄) and concentrated *in vacuo* to give the title compound as a white solid (1.05g, 78%):
δH (CDCl₃) 8.52 (2H, s), 4.94 (2H, br. s), 2.28 (1H, br. s).

INTERMEDIATE 6

3,5-Dichloro-4-bromomethylpyridine

A solution of Intermediate 5 (0.50 g, 2.80 mmol) in DCM (10 ml) was treated with thionyl bromide (3.51 g, 1.32 ml, 16.9 mmol) and heated to reflux for 3h. The reaction was quenched with 10% NaHCO₃ solution (10 ml) and extracted with DCM (25ml). The organic layer was dried (MgSO₄) and concentrated *in vacuo* to give the title compound as a yellow oil that solidified on standing (0.65 g, 96%) and was used without further purification: δH (CDCl₃) 8.50 (2H, s), 4.63 (2H, s); m/z (EI⁺, 60V) 242.

INTERMEDIATE 7

(S)-Ethyl (O-(3,5-dichloropyrid-4-yl)methyl)-L-tyrosine hydrochloride

The title compound was obtained by reaction of N-Boc-L-tyrosine ethyl ester with Intermediate 6 in the presence of sodium hydride, followed by Boc deprotection, using methods well known to a person skilled in the art: δH (DMSO d₆) 8.79-8.60 (3H, m), 7.20 (2H, d, J 8.6Hz), 7.00 (2H, d, J 8.6 MHz), 5.21 (2H, s), 4.34-4.20 (1H, m), 3.67 (3H, s); m/z (EI⁺, 70V) 355 and 357.

INTERMEDIATE 8

S-Ethyl 3-(4-nitrophenyl)-2-(6-chloropyrimidin-4-ylamino)propionate

A solution of 4-nitro-L-phenylalanine ethyl ester (3.22 g, 13.53 mmol), DIPEA (2.35ml, 1.75 g, 13.56 mmol) and 4,6-dichloropyrimidine (2.02 g, 13.55 mmol) in absolute ethanol (16 ml) was stirred at 70° for 18h under N₂. The volatiles were removed *in vacuo* and the residue partitioned between EtOAc (70 ml) and water (40 ml). The phases were separated and the aqueous phase re-extracted with EtOAc (2 x 30 ml). The combined organic extracts were washed with brine (10 ml), dried (Na₂SO₄) and evaporated *in vacuo* to afford a dark oil. Chromatography (silica, 2% MeOH/DCM) afforded the title compound as an orange oil which slowly solidified (4.03 g, 85%); δ H (CDCl₃) 8.39 (1H, s), 8.13 (2H, d, J 8.7Hz), 7.28 (2H, d, J 8.7Hz), 6.43 (1H, s), 5.55 (1H, br d, J 7.0Hz), 5.10-5.00 (1H, br m), 4.21 (2H, q, J 7.1Hz), 3.27 (1H, dd, J 13.8, 6.0Hz), 3.27 (1H, dd, J 13.8, 5.7Hz) and 1.26 (3H, t, J 7.1Hz); m/z (EI⁺, 100V) 351.

INTERMEDIATE 9

S- Ethyl 3-(4-aminophenyl)-2(6-chloropyrimidin-4-ylamino)propionate

A mixture of Intermediate 8 (1g, 2.85mmol) and 10% palladium on activated carbon (100mg) in absolute ethanol (40ml) was stirred under a hydrogen atmosphere (balloon) at room temperature for 1.5h. After degassing and N₂ flushing, the catalyst was removed by filtration through a Celite® pad and washed with DCM. The filtrate was evaporated *in vacuo* and the obtained yellow oil subjected to chromatography (silica: 3% MeOH/DCM). The title compound was isolated as a yellow oil (0.42g, 46%) δ H (CDCl₃) 8.33 (1H, s), 6.86 (2H, d, J 8.4Hz), 6.56 (2H, d, J 8.4Hz), 6.30 (1H, s), 5.27 (1H, br s), 4.84 (1H, br s), 4.19 (2H, q, J 7.1Hz), 3.64 (2H, br s), 3.10 (1H, dd, J 14.0, 5.6Hz), 3.01 (1H, dd, J 14.0, 6.1Hz) and 1.26 (3H, t, J 7.1Hz); m/z (EI⁺, 100V) 321.

INTERMEDIATE 10

S-Ethyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)-phenyl]-2-(4-methoxy-6-chloro-1,3,5-triazin-2-ylamino)propionate

Intermediate 3 (0.5g, 1.19mmol) in dry acetonitrile (5ml) under nitrogen was added to 2,4 dichloro-6-methoxy-1,3,5-triazine (0.26g, 1.43mmol). The mixture was cooled to -30° and DIPEA (0.46ml) was added slowly over 10 min. The reaction was allowed to warm to 5° over 2h and then ethyl acetate and aqueous sodium bicarbonate were added and the mixture shaken and separated. The organic layer was washed with water, dried (MgSO₄) and the solvent removed *in vacuo*. The product was purified by flash chromatography (silica; EtOAc/Hexane 1:1) to afford the title compound as a white solid (0.53g, 85%): δ H (DMSO d₆) 10.55 (1H, s), 8.70 (2H, s), 8.51-8.40 (1H, m), 7.50 (2H, d, J 8.4Hz), 7.29 (2H, d, J 8.4Hz), 4.60 (1H, m), 4.12 (2H, d, J 8.4Hz), 3.87 (3H, s), 3.23-3.15 (2H, m), 1.16 (3H, t, J 7.2Hz); m/z (EI⁺, 70V) 527.

INTERMEDIATE 11

S-Ethyl 3-(4-hydroxyphenyl)-2-[(4,6-dimethoxy-1,3,5-triazin-2-yl)amino]propionate

A mixture of L-tyrosine ethyl ester hydrochloride (0.50g, 2.0mmol) and DIPEA (0.74ml, 4.4mmol) in CH₃CN (8ml) was stirred at room temperature for 15 minutes and then 2-chloro-4,6-dimethoxy-1,3,5-triazine (0.43g, 2.2mmol) was added, and the reaction stirred overnight then concentrated *in vacuo*. The residue was partitioned between EtOAc (50ml) and NaHCO₃ solution (50ml). The organic layer was washed with 10% citric acid solution (50ml), NaHCO₃ solution (50ml) and water (50ml), dried (MgSO₄) and concentrated *in vacuo* to give the title compound as a colourless gum (0.48g, 68%): δ H (DMSO d₆) 6.90 (2H, d), 6.65 (2H, d), 5.90 (1H, m), 4.90 (1H, m), 4.10 (2H, m), 3.95 (3H, s), 3.90 (3H, s), 3.10 (2H, m), 1.20 (3H, t, J 7.1Hz); m/z (EI⁺ 70V) 349.

INTERMEDIATE 12

2.3-Bis(propylsulphonyl)pyrazine

Propanethiol (1.99ml, 22mmol) was added to a suspension of sodium hydride (60% in mineral oil, 880mg, 22mmol) in THF (50ml). After 10min, a solution of 2,3-dichloropyrazine (1.49g, 10mmol) in THF (15ml) was added and the mixture stirred at room temperature overnight. The reaction was quenched with water and the solvent removed *in vacuo*. The residue was dissolved in EtOAc, washed with water, 10% NaOH solution and brine, dried (Na₂SO₄) and evaporated *in vacuo* to give a pale yellow oil (2.7g). This was dissolved in DCM (100ml) at 0°, and mCPBA (57-86%, ~40mmol, 12.1 g) was added in portions. The mixture was stirred at room temperature overnight, then treated with Na₂SO₃ (aq). The organic phase was washed with NaHCO₃ (aq), dried (Na₂SO₄) and evaporated *in vacuo* to give the title compound as a white solid (3.18g): δ H (CDCl₃) 8.94 (2H, s), 3.58-3.63 (4H, m), 2.10-1.88 (4H, m), 1.10 (6H, t, J 7.4Hz); m/z (EI⁺, 70V) 293.

INTERMEDIATE 13

4,6-Bis(propylsulphonyl)pyrimidine

The title compound was prepared by the method of Intermediate 12 from 4,6-dichloropyrimidine: δ H (DMSO d₆) 9.77 (1H, d, J 1.3Hz), 8.40 (1H, d, J 1.3Hz), 3.61-3.56 (4H, m), 1.75-1.65 (4H, m), 0.97 (6H, t, J 7.5Hz); m/z (EI⁺, 70V) 293.

INTERMEDIATE 14

2-Chloro-3-phenoxyquinoxaline

A solution of phenol (564mg, 6mmol) in THF (5ml) was added to a suspension of sodium hydride (60% in mineral oil, 240mg, 6mmol) in THF (10ml). After 10min 2,3-dichloroquinoxaline (995mg, 5mmol) was added. The

mixture was stirred for 3 days. The solvent was removed *in vacuo*, the residue was dissolved in EtOAc, washed with NaOH (1M), dried (Na₂SO₄) and evaporated *in vacuo* to give a yellow solid. Recrystallisation from diisopropylether gave the title compound as off-white needles: δ H (DMSO d₆) 8.01-7.98 (1H, m), 7.77-7.67 (3H, m), 7.53-7.48 (2H, m), 7.37-7.30 (3H, m); m/z (EI⁺, 70V) 257.

INTERMEDIATE 15

Ethyl 2-(diethoxyphosphoryl)-3-(4-nitrophenyl)propionate

Ethyl 2-(diethoxyphosphoryl)acetate (5.0ml, 25.2mmol) was added to a suspension of sodium hydride (60% in mineral oil, 1.10g, 27.6mmol) in THF (40ml) at 0°. After 30min at room temperature, a solution of 4-nitrobenzylbromide (5.42g, 25.2mmol) in THF (40ml) was added over 30min. The reaction mixture was stirred for 2h at room temperature, quenched with water and partitioned between Et₂O and water. The aqueous phase was extracted with Et₂O and the combined organic layers washed with brine, dried (MgSO₄) and evaporated *in vacuo*. Column chromatography (silica; MeOH/DCM, 1:49) gave the title compound as a pale yellow oil (2.01g): δ H (CDCl₃) 8.13 (2H, d, J 8.8Hz), 7.37 (2H, d, J 8.8Hz), 4.23-4.06 (6H, m), 3.37-3.20 (3H, m), 1.35 (6H, t, J 7.1Hz), 1.16 (3H, t, J 7.1Hz); m/z (EI⁺, 70V) 360.

INTERMEDIATE 16

Ethyl 3-(4-aminophenyl)-2-(diethoxyphosphoryl) propionate

A mixture of Intermediate 15 (4.5g, 12.0mmol) and tin(II) chloride dihydrate (15g) in ethanol was stirred overnight. The solvent was removed *in vacuo*. DCM (100ml) and 1M NaOH (100ml) was added and the white precipitate removed by filtration. The organic phase of the filtrate was separated and evaporated *in vacuo*. The residue was acidified to pH1 with dil. HCl and extracted with diethyl ether. The aqueous phase was basified to pH10 with

Na₂CO₃ and extracted with EtOAc. The EtOAc extracts were dried (MgSO₄) and evaporated *in vacuo*. Column chromatography (silica; MeOH/DCM 5:95) gave the title compound as a yellow oil (2.19g): δ H (CDCl₃) 6.98 (2H, d, J 8.2Hz), 6.59 (2H, d, J 8.5Hz), 4.22-4.04 (6H, m), 3.25-3.02 (3H, m), 1.34 (6H, m), 1.16 (3H, t, J 7.1Hz): m/z (EI⁺, 70V) 330.

INTERMEDIATE 17

Ethyl 3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2(diethoxyphosphoryl)propionate

A solution of 3,5-dichloropyrid-4-ylcarbonyl chloride (1.41g, 6.7mmol) in THF (10ml) was added to a solution of Intermediate 16 (2.19g, 6.7mmol) and NMM (0.88ml, 8.0mmol) in THF (40ml). The mixture was stirred at room temperature overnight then partitioned between EtOAc and water. The aqueous layer was extracted with EtOAc and the combined organic layers washed with 10% aqueous HCl and NaHCO₃ (aq), dried (MgSO₄) and evaporated *in vacuo*. Column chromatography (silica; MeOH/DCM 95) gave the title compound as a yellow oil (2.61 g): δ H (CDCl₃) 8.55 (2H, s), 8.08 (1H, br. s), 7.55 (2H, d, J 8.5Hz), 7.21 (2H, d, J 8.5Hz), 4.19-4.08 (6H, m), 3.25-3.10 (3H, m), 1.35 (3H, t, J 7.1Hz), 1.34 (3H, t, J 7.1Hz), 1.18 (3H, t, J 7.1Hz).

INTERMEDIATE 18

Ethyl 2-[4-(3,5-dichloropyrid-4-ylcarboxamido)benzyl]acrylate

A mixture of Intermediate 17 (1.74g, 3.6mmol), potassium carbonate (1.48g, 10.7mmol) and aqueous paraformaldehyde (37% wt, 10ml) was heated at reflux for 4h. The mixture was partitioned between EtOAc and water. The aqueous phase was extracted with EtOAc and the combined organic layers washed with brine, dried (MgSO₄) and evaporated *in vacuo*. Column chromatography (silica; EtOAc/Hexane 50:50) gave the title compound as a white solid (1.09g):

δ H (CDCl₃) 8.52 (1H, br. s), 8.44 (2H, br. s), 7.49 (2H, d, J 8.5Hz), 7.18 (2H, d, J 8.5Hz), 6.22 (1H, br. s), 5.49 1H, br. s), 4.15 (2H, q, J 7.2Hz), 3.60 (2H, br. s), 1.27 (3H, t, J 7.2Hz).

5 **INTERMEDIATE 19**

Ethyl 3-amino-2-[4-(3,5-dichloropyrid-4-ylcarboxamido)benzyl] propionate

A mixture of Intermediate 18 (1.50g, 3.7mmol) and liquid ammonia (10ml) was kept in a sealed vessel for 3d at room temperature. Column chromatography (silica; MeOH/DCM 1:9 to 1:4) gave the title compound as a colourless oil (1.00g): δ H (DMSO d₆) 10.83 (1H, s), 8.78 (2H, d, J 8.5Hz), 7.54 (2H, d, J 8.5Hz), 7.16 (2H, d, J 8.5Hz), 4.00 (2H, q, J 7.1Hz), 3.29 (2H, br. s), 2.83-2.61 (5H, m), 1.10 (3H, t, J 7.1Hz): m/z (EI⁺, 70V) 396.

15 **INTERMEDIATE 20**

Ethyl 2-diazo-3-[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl] propionate

A solution of the compound of Intermediate 3 (free amine) (2.80g, 7.40mmol), glacial acetic acid (1.4ml, 24.50mmol), isoamyl nitrite (1 ml, 7.40mmol) in 100ml anhydrous chloroform were stirred at reflux under nitrogen for 1h. On cooling the solution was washed with water (2 x 25ml), saturated NaHCO₃ (2 x 25ml), water (2 x 25ml), dried (Na₂SO₄) and evaporated *in vacuo* to afford the title compound as a yellow solid (2.1 g, 100%): δ H (CDCl₃) 8.56 (2H, s), 7.72 (1H, br. s), 7.55 (2H, d, J 8.5Hz), 7.26 (2H, d, J 8.5Hz), 4.22 (2H, q, J 7.1Hz), 3.62 (2H, s), 1.25 (3H, t, J 7.1Hz).

25 **INTERMEDIATE 21**

5-Chloro-2-(2,5-dimethylpyrrol-1-yl)-pyridine

2-Amino-5-chloropyridine (10.0g, 77mmol), acetonyl acetone (8.8g, 77mmol) and a catalytic amount of p-toluenesulphonic acid in anhydrous toluene

(250ml) was heated to reflux for 5h under Dean and Stark conditions. The solvent was removed *in vacuo*; the residue slurried in hexane (250ml), filtered through celite and the solvent removed *in vacuo* to give the title compound as a yellow oil (16.0g): δ H (CDCl₃) 8.57 (1H, dd, J 2.7, 0.6Hz), 7.78 (1H, dd, J 8.4, 2.7Hz), 7.17 (1H, m, J 7.5, 0.5Hz), 5.91 (2H, s), 2.14 (6H, s).

INTERMEDIATE 22

5-Chloro-4-propylthio-2-(2,5-dimethylpyrrol-1-yl)-pyridine

To a solution of LDA (12.3mmol) in anhydrous toluene (6ml) at -78° under nitrogen was added Intermediate 21 (2.3g, 11.2mmol) in THF (6ml) dropwise over 15min. After stirring a further 15 min at this temperature n-propyl disulfide (1.92, 12.8mmol) in THF (2ml) was added dropwise maintaining the temperature at -78°. On completion of the addition the reaction was allowed to warm to room temperature and quenched with 10% NH₄Cl solution, diluted with EtOAc (50ml) and the phases separated. The organic phase was washed with water (2 x 10ml), dried (MgSO₄) and the solvent removed *in vacuo*. The residue was purified by chromatography (silica; 2% EtOAc/Hexane) to give the title compound (2.9g) as a yellow solid: δ H (CDCl₃) 8.39 (1H, s), 7.00 (1H, s), 5.92 (2H, s), 2.91 (2H, d, J 7.4Hz), 2.15 (6H, s), 1.74 (2H, m), 1.09 (3H, t, J 7.4Hz).

INTERMEDIATE 23

2-Amino-5-Chloro-4-propylthiopyridine

Intermediate 22 (1.3g, 4.6mmol) and hydroxylamine hydrochloride (1.6g, 23mmol) were heated to reflux in EtOH (12ml) and water (3.5ml) for 16h. The cooled solution was poured onto conc HCl (12ml)/water (48ml) and the resulting solid filtered, washed with water and dried to give the title compound as a brown solid (550mg): δ H (CDCl₃) 8.11 (1H, s), 6.91 (1H, s), 3.01 (2H, t, J 7.3Hz), 1.64 (2H, m), 1.00 (3H, t, J 7.3Hz): m/z (EI⁺, 70V) 203.

INTERMEDIATE 24

Resin bound (S)-2-(9-Fluorenylmethoxycarbonylamino)-3-[4-(3,5-dichloropyrid-4-yl carboxamido)phenyl]propanoic acid

Paramax Wang resin (Advanced Chemtech, 8.0g, 0.69mmol/g, 5.52mmol equivalent) in DCM (100ml) was treated with N- α -Fmoc-4-nitro-L-phenylalanine (11.93g, 27.6mmol), diisopropylcarbodiimide (4.32ml, 27.6mmol) and 4-N,N-dimethylaminopyridine (0.67g, 5.52mmol) and mixture was agitated at room temperature for 16h. The resin was filtered and washed with DMF, methanol and DCM, then air-dried. The resin was then treated with stannous chloride dihydrate (12.5g, 55.2mmol) in DMF (100ml) at room temperature for 6h, washed with DMF, methanol and DCM, then air dried overnight. The resin was treated with pyridine (4.44ml, 55.2mmol), 3,5-dichloropyrid-4-carbonyl chloride 3.52g, 16.56mmol) and 4-N,N-dimethylamino pyridine (0.67g, 5.52mmol) in DCM (100ml). The reaction mixture was agitated at room temperature for 16h. The resin was then washed with DMF, methanol and DCM, then with two 50ml portions of a 10% solution of pyridine in DMF (100ml). The resin was further washed with hot ethanol (2 x 100ml), DMF, methanol and DCM then air-dried to give the title compound.

INTERMEDIATE 25

Resin bound 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl]-2-diazopropanoic acid

A portion of Intermediate 24 (3.0g) was treated twice with a 20% solution of piperidine in DMF (100ml), once for 5min and once for 15min. The resin was washed with DMF, methanol and DCM. This material was treated with isoamyl nitrite (1.79ml, 12.30mmols) and acetic acid (0.074ml, 1.23mmols) in anhydrous chloroform (70ml) for 1 hr, then filtered and washed with DMF, methanol and DCM then finally air dried to give the title compound.

EXAMPLE 1

S-Methyl-3-[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl]-2-(4,6-dimethoxy-1,3,5-triazin-2-ylamino)propionate

A solution of Intermediate 4 (330mg, 0.90mmol), DIPEA (163 μ l, 121mg, 0.94mmol), and 2-chloro-4,6-dimethoxy-1,3,5-triazine (233mg, 1.32mmol) in MeOH (2ml) was stirred under gentle reflux for 7h under N₂. The volatiles were removed *in vacuo* and the residue partitioned between EtOAc (80ml) and saturated aqueous NaHCO₃ (30ml). The phases were separated and the aqueous layer re-extracted with EtOAc (40ml). The combined organic extracts were washed with brine (10ml), dried (Na₂SO₄) and evaporated *in vacuo* to afford a straw-coloured oil. Chromatography (silica; 4% MeOH/DCM) afforded the title compound as a colourless foam (330mg, 73%): δ H (CDCl₃) 8.46 (2H, s), 8.32 (1H, s), 7.51 (2H, d, J 84Hz), 7.12 (2H, d, J 8.4Hz), 6.17 (2H, d, J 8.0Hz), 5.00 (1H, d, J 13.8, 6.0Hz), 3.92 (3H, s), 3.89 (3H, s) and 3.75 (3H, s); m/z (EI⁺, 160V) 507, 509.

EXAMPLE 2

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(4,6-dimethoxy-1,3,5-triazin-2-ylamino)propanoic acid

A solution of the compound of Example 1 (300mg, 0.59mmol) and LiOH•H₂O (0.88mmol) in dioxane (2ml), MeOH (1ml) and water (2ml) was stirred at room temperature for 1h. The pH was made acidic with a few drops of AcOH and the volatiles removed *in vacuo*. The residue was chromatographed [silica; DCM (400->200), MeOH (20), AcOH (3), H₂O (2)) affording the product as a colourless oil. Freeze drying from aqueous MeOH gave the title compound as a white amorphous solid (215mg, 76%). δ H (d₆ DMSO) 10.84 (1H, s), 8.77 (2H, s), 8.10 (1H, d, J 8.0Hz), 7.54 (2H, d, J 8.4Hz), 7.29 (2H, d, J 8.4Hz),

4.58-4.48 (1H, m), 3.80 (3H, s), 3.78 (3H, s), 3.12 (1H, dd, J 14.0, 4.7Hz) and 2.98 (1H, dd, J 14, 10.2Hz). m/z (EI⁺ 100V), 493, 495, 497.

EXAMPLE 3

S-Ethyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl]-2-(6-chloropyrimidin-4-ylamino)propionate

3,5-Dichloropyrid-4-carbonyl chloride (289mg, 1.37mmol) was added to a stirred solution of Intermediate 9 (400mg, 1.25mmol) and NMM (150 μ l, 139mg, 1.37mmol) in dry DCM (10ml). After stirring for 1h at room temperature under N₂, the reaction mixture was partitioned between DCM (70ml) and saturated aqueous NaHCO₃ (30ml). The phases were separated and the aqueous layer re-extracted with DCM (50ml). The combined organic extracts were washed with brine (10ml), dried (Na₂SO₄) and evaporated *in vacuo*. The obtained orange oil was chromatographed (silica; 5% MeOH/DCM) to afford the title compound as a straw-coloured foam (504mg, 82%); δ H (CDCl₃) 8.48 (2H, s), 8.41 (1H, s), 8.32 (1H, s), 7.48 (2H, d, J 8.4Hz), 7.08 (2H, d, J 8.4Hz), 6.38 (1H, s), 5.72 (1H, br s), 4.96 (1H, br s), 4.22 (2H, q, J 7.1Hz), 3.25 (1H, dd, J 14.0, 5.5Hz), 3.14 (1H, dd, J 14.0, 5.8Hz) and 1.21 (3H, t, J 7.1Hz); m/z (EI⁺, 160V) 496.

EXAMPLE 4

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(6-chloropyrimidin-4-ylamino)propanoic acid

A solution of Example 3 (475 mg, 0.96mmol) and LiO•H₂O (40mg, 0.96mmol) in dioxane (5ml), MeOH (3ml) and water (3ml) was stirred at room temperature for 2.5h. A few drops of AcOH were added and the volatiles removed *in vacuo*. The residue was chromatographed [silica; DCM (200), MeOH (20), AcOH (3), H₂O (2)] to afford the product as a slightly yellow oil. The oil was dissolved in a small volume of MeOH, diluted with water and freeze-dried to

give the title compound as an off-white amorphous solid (290mg, 65%); Found: C, 47.67; H, 2.9; N, 14.65. $C_{19}H_{14}Cl_3N_5O_3 \cdot 0.66 H_2O$ requires C, 47.67; H, 3.23; N, 14.63%. δH (d_6 DMSO) 10.86 (1H, s), 8.78 (2H, s), 8.26 (1H, s), 7.98 (1H, br d, J 7.6Hz), 7.55 (2H, d, J 8.2Hz), 7.25 (2H, d, J 8.2Hz), 6.66 (1H, s), 4.76 (1H, br s), 3.16 (1H, dd, J 13.9, 4.7Hz) and 2.98 (1H, dd, J 13.9, 8.9Hz); m/z (EI⁺, 160V) 468.

EXAMPLE 5

S-Ethyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)]phenyl]-2-(6-propylthiopyrimidin-4-ylamino)propionate

A solution of Intermediate 3 (2.0g, 4.8mmol), DIPEA (1.29g, 1.74ml, 10 mmol) and 4-chloro-6-propylthio-pyrimidine (1.08g, 5.7mmol) in 2-ethoxyethanol (8ml) was heated at 110° for 2 days and 130° for 2 days under nitrogen. The volatiles were removed *in vacuo* and the dark oil partitioned between EtOAc (100ml) and 5% aqueous citric acid (40ml). The phases were separated and the aqueous layer re-extracted with EtOAc (2 x 30ml). The combined organic extracts were washed consecutively with saturated aqueous NaHCO₃ (20ml), water (20ml), brine (20ml), dried (Na₂SO₄) and treated with activated carbon, filtered and evaporated *in vacuo*. The obtained oil was purified by chromatography (silica; 2-3% MeOH/DCM) to afford the title compound (together with 20% of the ethoxyethyl ester analogue) as a pale yellow foam (1.26g, 49%): δH (CDCl₃) 8.56 (2H, s), 8.38 (1H, s), 7.68 (1H, s), 7.53 (2H, d, J 8.6Hz), 7.13 (2H, d, J 8.6Hz), 6.20 (1H, s), 5.23-5.12 (1H, m), 5.00-4.84 (1H, m), 4.21 (2H, q, J 7.1Hz), 3.26 (1H, dd, J 14.0, 5.3Hz), 3.15 (1H, dd, J 14.0, 5.7Hz), 3.06 (2H, t, J 7.3Hz), 1.71 (2H, hex, J 7.3Hz), 1.29 (3H, t, J 7.1Hz), 1.04 (3H, t, J 7.3Hz); m/z (EI⁺, 100V) 520.

EXAMPLE 6

S-Ethyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)-phenyl]-2-(6-propylsulphonylpyrimidin-4-ylamino)propionate

mCPBA (assumed 60% pure, 1.43g, 4.96mmol) was added to a solution of the compound of Example 5 (1.26g, 2.36mmol) in dry DCM (20ml), and stirred at room temperature for 4h. 10% aqueous sodium sulphite (20ml) was added and stirred for 5 min. After diluting with DCM (130ml) and shaking, the phases were separated. The organic phase was washed consecutively with saturated aqueous NaHCO₃ (3 x 30ml), water (25ml) and brine (10ml), dried (Na₂SO₄) and evaporated *in vacuo*. Chromatography (silica; 2% MeOH/DCM) afforded the title compound as a pale yellow foam (640mg, 50%): δ H (CDCl₃) 8.63 (1H, s), 8.50 (2H, s), 8.05 (1H, s), 7.47 (2H, d, J 8.6Hz), 7.10 (2H, d, J 8.6Hz), 6.22-6.13 (1H, br. m), 5.18-5.08 (1H, br. m), 4.24 (2H, q, J 7.4Hz), 3.32-3.25 (2H, m), 3.17 (1H, dd, J 14.1, 6.2Hz), 1.75 (2H, hex, J 7.4Hz), 1.31 (3H, t, J 7.1Hz), 1.03 (3H, t, J 7.4Hz); m/z (EI⁺, 100V) 566.

EXAMPLE 7

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(6-propylsulphonylpyrimidin-4-ylamino)propanoic acid

The title compound (395mg, 66%) was prepared from the compound of Example 6 (630 mg, 1.11 mmol) by hydrolysis in a similar manner to Example 2: δ H (DMSO d₆) 10.85, (1H, s), 8.77 (2H, s), 8.56 (1H, s), 8.44 (1H, d, J 7.8Hz), 7.55 (2H, d, J 8.4Hz), 7.26 (2H, d, J 8.4Hz), 7.22 (1H, s), 4.85-4.72 (1H, br. m), 3.33 (2H, t, J 7.6 Hz), 3.18 (1H, dd, J 13.8, 4.7Hz), 2.99 (1H, dd, J 13.8, 9.1Hz), 1.59 (2H, hex, J 7.6Hz), 0.93 (3H, t, J 7.6Hz); m/z (EI⁺, 70V) 538.

EXAMPLE 8

S-Ethyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)-phenyl]-2-(6-propylsulphinylypyrimidin-4-ylamino)propionate

mCPBA (assumed 86% pure, 223mg, 1.11 mmol) was added to an ice-bath cooled solution of the compound of Example 5 (500mg, 0.94mmol) in dry DCM (15ml), and stirred for 1h with cooling and for 2h at room temperature. 10% aqueous sodium sulphite (10ml) and DCM (100ml) was added and the mixture vigorously stirred for 5 min. The phases were separated and the organic phase was washed consecutively with saturated aqueous NaHCO₃ (2 x 30ml), water (10ml) and brine (10ml), dried (Na₂SO₄) and evaporated *in vacuo*.

Chromatography (silica; 2-3% MeOH/DCM) afforded the title compound as a mixture of diastereoisomers together with a small amount of the corresponding ethoxyethyl analogue (330mg, 64%): δ H (CDCl₃) 8.82-8.80 (1H, s), 8.49-8.45 (3H, s), 7.53-7.47 (2H, overlapping d's, J 8.6Hz), 7.17-7.08 (2H, overlapping d's J 8.6Hz), 7.01-6.95 (1H, s), 6.31-6.22 (1H, m), 5.20-5.00 (1H, br. m), 4.30-4.15 (2H, overlapping q's, J 7Hz), 3.87-3.12 (2H, br. m), 3.10-3.01 (1H, br. m), 2.87-2.70 (1H, br. m), 1.92-1.74 (1H, br. m), 1.69-1.50 (1H, br. m), 1.33-1.20 (3H, t, J 7Hz), 1.08-0.99 (3H, overlapping t's, J 7Hz); m/z (EI⁺, 70V) 550.

EXAMPLE 9

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(6-propylsulphinylypyrimidin-4-ylamino)propanoic acid

The title compound as a 1:1 mixture of diastereoisomers (278mg, 92%) was prepared from the compound of Example 8 (320 mg, 0.58 mmol) by hydrolysis in a similar manner to Example 2; δ H (DMSO d₆) 10.85 (1H, s), 8.77 (2H, s), 8.40 (1H, s), 8.25 (1H, d, J 7.6Hz), 7.55 (2H, d, J 8.3Hz), 7.30-7.20 (2H, m), 7.09 (1H, s), 4.82-4.69 (1H, m), 3.17 (1H, dd, J 14, 4Hz), 3.12-2.90

(2H, br. m), 2.85-2.72 (1H, m), 1.80-1.62 (1H, m), 1.55-1.37 (1H, m), 1.01-0.90 (3H, overlapping t's); m/z (EI⁺, 70V) 522.

EXAMPLE 10

S-Ethyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)-phenyl]-2-(6-benzylthiopyrimidin-4-ylamino)propionate

A solution of Intermediate 3 (1.0g, 2.39mmol), DIPEA (647mg, 872 μ l, 5 mmol) and 4-benzylthio-6-chloro-pyrimidine (678mg, 2.87mmol) in 2-ethoxyethanol (4ml) was heated at 120° for 58h. The volatiles were removed *in vacuo* and the residue worked up in a manner analogous to that described for Example 5. The crude product was chromatographed (silica; 2-3% MeOH/DCM) to afford the title compound (together with some of the ethoxyethyl ester analogue) as a near colourless glassy solid (560mg, 40%): δ H (CDCl₃) 8.55 (2H, s), 8.42 (1H, s), 7.73 (1H, s), 7.51 (2H, d, J 8.4Hz), 7.39-7.24 (m, 5H), 7.11 (2H, d, J 8.4Hz), 6.19 (1H, s), 5.27-5.18 (1H, m), 4.95-4.81 (1H, m), 4.37 (2H, s), 4.21 (2H, q, J 7.1Hz), 3.21 (1H, dd, J 14.0, 5.0Hz), 3.15 (1H, dd, J 14.0, 5.7Hz), 1.28 (3H, t, J 7.1Hz); m/z (EI⁺, 70V) 582.

EXAMPLE 11

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido) phenyl]-2-(6-benzylthiopyrimidin-4-ylamino)propanoic acid

The title compound was prepared from the compound of Example 10 by hydrolysis in a similar manner to Example 2: δ H (DMSO d₆, 390K) 10.84 (1H, br. s), 8.77 (2H, s), 8.24 (1H, s), 7.55-7.25 (7H, m), 6.46 (1H, s), 4.66 (1H, m), 4.31 (2H, s), 3.13-2.90 (2H, m); m/z (EI⁺, 70V) 554.

EXAMPLE 12

S-Ethyl 3-[3-Chloro-4-(3,5-dichloropyrid-4-ylcarboxamido)-phenyl]-2-(6-diethylaminosulphonylpyrimidin-4-ylamino)propionate and S-Ethyl 3-[3,5-dichloro-4-(3,5-dichloropyrid-4-ylcarboxamido)-phenyl]-2-(6-diethylaminosulphonylpyrimidin-4-ylamino)propionate

Chlorine gas was bubbled through a vigorously stirred ice-bath cooled mixture of the compound of Example 10 (550mg), DCM (8ml) and 10% aqueous HCl (20ml). The cooled reaction mixture was then stirred for an additional 30min. Excess chlorine was removed by purging with nitrogen and the reaction mixture diluted with DCM (70ml). The phases were shaken, separated and the aqueous phase re-extracted with DCM (30ml). The combined organic extracts were treated with diethylamine (2ml) and left to stand for 45min. The volatiles were removed *in vacuo* and the residue partitioned between EtOAc (70ml) and water (20ml). The phases were separated and the aqueous phase re-extracted with EtOAc (2 x 15ml). The combined organic extracts were washed with brine (10ml), dried (MgSO₄) and evaporated *in vacuo*. The obtained dark foam was chromatographed twice (silica; 2% MeOH/DCM then 25%Et₂O/DCM) affording a 2:1 mixture of the title compounds (240mg): δ H (CDCl₃) 8.62 (1H, s), 8.59 (2H x 0.66, s), 8.57 (2H x 0.33, s), 8.31 (1H x 0.66, s), 7.85 (1H x 0.33, s), 7.20 (2H x 0.33, s), 7.11 (1H x 0.66, d, J 8.4Hz), 5.84-5.72 (1H, br. m), 5.18-4.95 (1H, br. m), 4.26 (2H, q, J 7.1Hz), 3.39 (2H, q, J 7.1Hz), 3.28 (1H, dd, J 14.0, 5.3Hz), 3.17 (1H, dd, J 14.0, 5.6Hz), 1.32 (3H x 0.33, t, J 7.1Hz), 1.30 (3H x 0.66, t, J 7.1Hz), 1.17 (6H, t, J 7.1Hz); m/z (EI⁺, 70V) 531 and 665.

EXAMPLE 13

S-3-[3-Chloro-4-(3,5-dichloropyrid-4-ylcarboxamido)-phenyl]-2-(6-
diethylaminosulphonylpyrimidin-4-ylamino)propanoic acid and
S-3-[3,5-dichloro-4-(3,5-dichloropyrid-4-ylcarboxamido)- phenyl]-2-
(6-diethylaminosulphonylpyrimidin-4-ylamino)propanoic acid

The mixture of compounds of Example 12 (240mg, 0.38mmol) was treated with a solution of LiOH.2H₂O (27mg, 0.64mmol) in dioxan (3ml) and water (3ml) at room temperature for 2.5h. A few drops of acetic acid were added and the volatiles were removed *in vacuo*. The residue was chromatographed several times (silica; DCM (400-200), MeOH (20), AcOH (3), H₂O (2)) to separate the two title compounds, affording after freeze-drying from aqueous methanol, the less polar

S-3-[3-Chloro-4-(3,5-dichloropyrid-4-ylcarboxamido)-phenyl]-2-(6-
diethylaminosulphonyl pyrimidin-4-ylamino)propanoic acid as a white amorphous solid (105mg, 49%): δ H (DMSO d₆) 10.61 (1H, s), 8.75 (2H, s), 8.50 (1H, s), 8.31 (1H, d, J 7.8Hz), 7.62, (1H, d, J 8.1Hz), 7.43 (1H, s), 7.28 (1H, d, J 8.1Hz), 7.10 (1H, s), 4.83-4.75 (1H, m), 3.26 (4H, t, J 7.1Hz), 3.22 (1H, m), 3.05 (1H, dd, J 13.8, 9.1Hz), 1.05 (6H, t, J 7.1Hz); m/z (ES⁺, 70V) 603; and the more polar S-3-[3,5-dichloro-4-(3,5-dichloropyrid-4-ylcarboxamido)- phenyl]-2-
(6-diethylaminosulphonylpyrimidin-4-ylamino)propanoic acid as a white

amorphous solid (49mg, 21%): δ H (DMSO d₆) 10.83 (1H, s), 8.76 (2H, s), 8.50 (1H, s), 8.29 (1H, d, J 7.8Hz), 7.44 (2H, s), 7.12 (1H, s), 4.85-4.74 (1H, m), 3.26 (4H, t, J 7.1Hz), 3.20 (1H, m), 3.05 (1H, dd, J 13.8, 9.9Hz), 1.05 (6H, t, J 7.1Hz); m/z (EI⁺, 70V) 637.

EXAMPLE 14

S-Ethyl 3-[3-Chloro-4-(3,5-dichloropyrid-4-ylcarboxamido)-phenyl]-2-(6-propylaminosulphonylpyrimidin-4-ylamino)propionate

The title compound (430mg) was prepared in an analogous manner to the compound of Example 12 starting from the compound of Example 10 (500mg) and using n-propylamine: δ H (CDCl₃) 8.63 (1H, s), 8.60 (2H, s), 8.45 (1H, s), 8.32 (1H, d, J 7.8Hz), 7.88 (1H, s), 7.25-6.98 (3H, m), 6.02-5.90 (1H, m), 5.13-5.06 (1H, m), 4.28 (2H, q, J 7.1Hz), 3.38-3.15 (2H, m), 3.04 (2H, q, J 7.1Hz), 1.53 (2H, q, J 7.1Hz), 1.24 (3H, t, J 7.1Hz), 0.97 (3H, t, J 7.1Hz); m/z (EI⁺, 70V) 627.

EXAMPLE 15

S-3-[3-Chloro-4-(3,5-dichloropyrid-4-ylcarboxamido)-phenyl]-2-(6-propylaminosulphonylpyrimidin-4-ylamino)propanoic acid

The title compound (151 mg, 66%) was prepared from the compound of Example 14 (394 mg, 0.60 mmol) by hydrolysis in a similar manner to Example 2: δ H (DMSO d₆) 10.61 (1H, s), 8.76 (2H, s), 8.51 (1H, s), 8.32 (1H, d, J 7.8Hz), 7.80 (1H, t, J 5.7Hz), 7.63 (1H, d, J 8.3Hz), 7.45 (1H, s), 7.29 (1H, d, J 8.3Hz), 7.10 (1H, s), 4.85-4.74 (1H, m), 3.22 (1H, dd, J 13.9, 4.9Hz), 3.02 (1H, dd, J 13.9, 9.0Hz), 2.86 (2H, t, J 6.8Hz), 1.38 (2H, hex, J 6.8Hz), 0.79 (3H, t, J 7.3Hz); m/z (EI⁺, 70V) 589.

EXAMPLE 16

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(6-methoxy-2-methylsulphonylpyrimidin-4-ylamino)propanoic acid

The title compound was prepared from Intermediate 3 and 2,4-di-(methylsulphonyl)-6-methoxypyrimidine by a method similar to that described for Intermediate 10 followed by ester hydrolysis according to the method of Example

2: δ H (DMSO d_6) 12.70 (1H, br. s), 10.84 (1H, s), 8.77 (2H, s), 8.23 (d, J 7.6Hz) and 8.08 (d, J 7.7Hz) together (1H), 7.54 (2H, d, J 8.0Hz), 7.33 (2H, d, J 8.0Hz), 6.48 (1H, s), 4.55-4.46 (1H, m), 3.89 (s) and 3.86 (s) together (3H), 3.20-3.03 (2H, m); m/z (EI⁺, 70V) 540.

5

EXAMPLE 17

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(6-methoxy-2-propylsulphonylpyrimidin-4-ylamino)propanoic acid

10 The title compound was prepared from Intermediate 3 and 2,4-di n-propylsulphonyl-6-methoxypyrimidine by a method similar to that described for Intermediate 10 followed by ester hydrolysis according to the method of Example 2: δ H (DMSO d_6) 12.69 (1H, br.s), 10.83 (1H, s), 8.77 (2H, s), 8.18 (d, J 7.9Hz) and 8.06 (d, J 7.9Hz) together (1H), 7.54 (2H, d, J 8.2Hz), 7.32 (2H, d, J 8.2Hz), 6.48 (s) and 6.47 (s) together (1H), 4.55-4.42 (1H, m), 3.89 (s) and 3.86 (s) together (3H), 3.29 (2H, q, J 7.7Hz), 3.12 (1H, dd, J 13.9, 4.6Hz), 3.02 (1H, dd, J 13.9, 9.9Hz), 1.68-1.49 (2H, m), 0.94 (t, J 7.2Hz) and 0.92 (t, J 7.2Hz) together (3H); m/z (EI⁺, 70V) 568 and 570.

15

EXAMPLE 18

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(4-trifluoromethylpyrimidin-2-ylamino)propanoic acid

20

25 The title compound was prepared from Intermediate 3 and 2-chloro-4-(trifluoromethyl)pyrimidine, followed by hydrolysis: δ H (DMSO d_6) 12.70 (1H, br.s), 10.83 (1H, s), 8.77 (2H, s), 8.58 (1H, d, J 4.9Hz), 8.15 (d, J 8.0Hz) and 8.06 (d, J 8.0Hz) together (1H), 7.54 (2H, d, J 8.2Hz), 7.33 (2H, d, J 8.2Hz), 6.99 (1H, d, J 4.9Hz), 4.62-4.42 (1H, br. m), 3.15 (1H, dd, J 13.7, 4.4Hz), 3.10-2.95 (1H, m) m/z (EI⁺, 60V) 500 and 502.

25

EXAMPLE 19

**S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(6-phenoxy-
pyrimidin-4-ylamino)propanoic acid**

The title compound was prepared from Intermediate 3 and 4-chloro-6-
5 phenoxy-pyrimidine, followed by hydrolysis: δ H (DMSO d_6) 10.85 (1H, s), 8.77
(2H, s), 8.12 (1H, s), 7.60 (1H, br. d, J 8.0Hz), 7.54 (2H, d, J 8.3Hz), 7.41 (2H,
t, J 7.8Hz), 7.27-7.20 (3H, m), 7.12 (2H, d, J 8.2Hz), 5.88 (1H, s), 4.80-4.60
(1H, br. m), 3.12 (1H, dd, J 13.8, 4.7Hz), 2.90 (1H, dd, J 13.8, 9.5Hz); m/z
(EI⁺, 60V) 524 and 526.

EXAMPLE 20

**S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(2-methylthio-
pyrimidin-4-ylamino)propanoic acid**

The title compound was prepared from Intermediate 3 and 4-chloro-2-
15 methylthio-pyrimidine followed by hydrolysis: δ H (DMSO d_6) 10.83 (1H, s), 8.77
(2 H, s), 7.85 (1H, d, J 5.7Hz), 7.71 (1H, br. s), 7.54 (1H, d, J 8.5Hz), 7.25
(1H, d, J 8.5Hz), 6.28 (1H, d, J 5.7Hz), 4.70-4.53 (1H, br. m), 3.12 (1H, dd, J
14.0, 8.0Hz), 2.96 (1H, dd, J 14.0, 8.0Hz); m/z (EI⁺, 60V) 478.

EXAMPLE 21

**S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(5-carboxy-2-
methylthio-pyrimidin-4-ylamino)propanoic acid**

The title compound was prepared from Intermediate 3 and ethyl 4-chloro-
2-methylthio-pyrimidine-5-carboxylate, followed by hydrolysis: δ H (DMSO d_6)
25 10.87 (1H, s), 9.01 (1H br. s), 8.77 (2H, s), 8.49 (1H, s), 7.55 (2H, d, J 8.4Hz),
7.20 (2H, d, J 8.4Hz), 4.90-4.80 (1H, m), 3.21 (1H, dd, J 13.8, 5.2Hz), 3.09
(1H, dd, J 13.8, 6.9Hz), 2.44 (3H, s); m/z (EI⁺, 60V) 522.

EXAMPLE 22

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(5-ethoxycarboxy-2-methylthiopyrimidin-4-ylamino)propanoic acid

The title compound was prepared from Intermediate 3 and ethyl 4-chloro-2-methylthiopyrimidine-5-carboxylate with subsequent partial hydrolysis of the coupled product: δ H (DMSO d_6) 10.84 (1H, br. s), 8.77 (2H, s), 8.55 (1H, s), 8.47 (1H, d, J 6.8Hz), 7.54 (2H, d, J 8.3Hz), 7.18 (2H, d, J 8.3Hz), 4.94-4.83 (1H, m), 4.25 (2H, q, J 7.1Hz), 3.25 (1H, dd, J 13.8, 5.3Hz), 3.13 (1H, dd, J 13.8, 6.8Hz), 2.46 (3H, s), 1.26 (3H, t, J 7.1Hz); m/z (EI⁺, 60V) 550.

EXAMPLE 23

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(3-nitropyrid-2-ylamino)propanoic acid

The title compound was prepared from Intermediate 3 and 2-chloro-3-nitropyridine, followed by hydrolysis: δ H (DMSO d_6) 10.86 (1H, s), 8.77 (2H, s), 8.49-8.43 (2H, m), 8.29 (1H, d, J 7.0Hz), 7.55 (2H, d, J 8.5Hz), 7.22 (2H, d, J 8.5Hz), 6.84 (1H, dd, J 8.3, 4.5Hz), 5.03-4.99 (1H, m), 3.30-3.15 (2H, m); m/z (EI⁺, 60V) 476 and 478.

EXAMPLE 24

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(5-nitropyrid-2-ylamino)propanoic acid

The title compound was prepared from Intermediate 3 and 2-chloro-5-nitropyridine, followed by hydrolysis: δ H (DMSO d_6) 10.84 (1H, s), 8.85 (1H, d, J 2.6Hz), 8.76 (2H, s), 8.32 (1H, d, J 7.4Hz), 8.10 (1H, dd, J 9.4, 2.6Hz), 7.54 (2H, d, J 8.3Hz), 7.26 (2H, d, J 8.3Hz), 6.69 (1H, d, J 9.4Hz), 4.81 (1H, br. m), 3.19 (1H, dd, J 13.9, 4.7Hz), 3.00 (1H, dd, J 13.9, 9.2Hz); m/z (EI⁺, 60V) 476 and 478.

EXAMPLE 25

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(6-propylthiopyrimidin-4-ylamino)propanoic acid

The title compound was prepared by hydrolysis of the compound of
Example 5: δ H (DMSO d_6) 10.83 (1H, br. s), 8.77 (2H, s), 8.21 (1H, s), 7.54
(2H, d, J 8.4Hz), 7.24 (2H, d, J 8.4Hz), 6.43 (1H, br. s), 4.67 (1H, br. s), 3.13
(1H, dd, J 13.9, 4.8Hz), 3.00-2.90 (3H, m), 1.61 (2H, hex, J 7.3Hz), 0.95 (3H,
t, J 7.3Hz); m/z (EI⁺, 160V) 506 and 508.

EXAMPLE 26

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(2-nitrophenylamino)propanoic acid

The title compound was prepared from Intermediate 3 and 2-fluoronitrobenzene, followed by hydrolysis: δ H (DMSO d_6) 10.86 (1H, br. s),
8.76 (2H, s), 8.20 (1H, d, J 7.7Hz), 8.08 (1H, dd, J 8.6, 1.6Hz), 7.56 (2H, d, J
8.5Hz), 7.53 (1H, m), 7.16 (2H, d, J 8.5Hz), 7.04 (1H, d, J 8.2Hz), 6.74 (1H, t,
 J 7.5Hz), 4.79-4.73 (1H, m), 3.26-3.13 (2H, m); m/z (EI⁺, 60V) 476 and 478.

EXAMPLE 27

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(pyrimidin-2-ylamino)propanoic acid

The title compound was prepared from Intermediate 3 and 2-chloropyrimidine, followed by hydrolysis: δ H (DMSO d_6) 10.82 (1H, br. s), 8.76
(2H, s), 8.23 (2H, d, J 4.7Hz), 7.52 (2H, d, J 8.3Hz), 7.27 (2H, d, J 8.3Hz),
7.12 (1H, d, J 7.5Hz), 6.57 (1H, t, J 4.7Hz), 4.50-4.40 (1H, m), 3.12 (1H, dd, J
13.8, 4.5Hz), 3.00 (1H, dd, J 13.8, 9.1Hz); m/z (EI⁺, 60V) 432 and 434.

EXAMPLE 28

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(6-methylsulphonylpyrimidin-4-ylamino)propanoic acid

The title compound was prepared from Intermediate 3 and 2,4-di-
5 (methylsulphonyl)-pyrimidine, followed by hydrolysis: δ H (DMSO d_6) 8.79 (2H, s), 8.58 (1H, s), 8.47 (1H, d, J 7.8Hz), 7.57 (2H, d, J 8.5Hz), 7.28 (2H, d, J 8.5Hz), 7.21 (1H, s), 4.79 (1H, m), 3.20 (3H, s), 3.19 (1H, m), 3.00 (1H, dd, J 13.9, 9.2Hz); m/z (EI⁺, 70V) 510.

EXAMPLE 29

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(2-propylsulphonylpyrimidin-4-ylamino)propanoic acid

The title compound was prepared from Intermediate 3 and Intermediate 13,
followed by hydrolysis: δ H (DMSO d_6) 8.60 (2H, s), 8.10 (1H, d, J 6.0Hz), 7.50
15 (2H, d, J 8.5Hz), 7.28 (2H, d, J 8.5Hz), 6.70 (1H, d, J 6.0Hz), 4.90 (1H, m), 3.30 (4H, m), 3.10 (1H, m), 1.20 (2H, m), 1.00 (3H, t, J 7.1Hz); m/z (EI⁺, 70V) 538.

EXAMPLE 30

S-Ethyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)-phenyl]-2-(4-methoxy-6-dimethylamino-1,3,5-triazin-2-ylamino)propionate

To a solution of Intermediate 10 (0.26g, 0.50mmol) in dry THF (5ml)
under nitrogen was added dimethylamine (941mg, 0.5mmol) and DIPEA (0.17ml).
The solution was stirred at room temperature for 4.5h then the solvent was
25 removed *in vacuo* and DCM (10ml) was added. The organic layer was washed
with aqueous sodium bicarbonate and water, dried (MgSO₄) and the solvent
removed *in vacuo*. Flash chromatography (silica; EtOAc/Hexane 1:1) gave the
title compound as a froth (0.16g, 59%): δ H (CDCl₃) 8.55 (2H, s), 7.75 (1H, br.

s), 7.54 (2H, d, J 8.4Hz), 7.18 (2H, d, J 8.4Hz), 5.40 (1H, m), 4.90 (1H, m), 4.17 (2H, d, J 7.2Hz), 3.84 (3H, s), 3.28-3.10 (2H, m), 3.11 (6H, s), 1.16 (3H, t, J 7.2Hz); m/z (EI^+ , 70V) 534.

5 **EXAMPLE 31**

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(4-methoxy-6-dimethylamino-1,3,5-triazin-2-ylamino)propanoic acid

The title compound was prepared from the compound of Example 30 by hydrolysis in a similar manner to Example 2: δH (DMSO d_6) 10.83 (1H, s), 8.77 (2H, s), 7.53 (2H, d, J 8.0Hz), 7.38 (1H, m), 7.28 (2H, d, J 7.9Hz), 4.72 (1H, m), 3.72 (3H, d, J 4.2Hz), 3.00 (8H, d, J 4.5Hz); m/z (EI^+ , 60V) 506.

In a similar manner were prepared the following compounds of Examples 32-49

15 **EXAMPLE 32**

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(4-methoxy-6-diethylamino-1,3,5-triazin-2-ylamino)propanoic acid

Prepared from Intermediate 10 and diethylamine, followed by hydrolysis: δH (DMSO d_6 , 390K) 10.39 (1H, br. s), 8.65 (2H, s), 7.50 (2H, d, J 8.3Hz), 7.25 (2H, d, J 8.3Hz), 6.41 (1H, br. m), 4.55 (1H, br. m), 3.54 (4H, dd, J 6.9Hz), 3.39 (3H, s), 3.20-3.00 (2H, m), 1.11 (6H, t, J 6.9Hz); m/z (EI^+ , 60V) 534.

EXAMPLE 33

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(4-methoxy-6-morpholino-1,3,5-triazin-2-ylamino)propanoic acid

Prepared from Intermediate 10 and morpholine, followed by hydrolysis:

5 δ H (DMSO d_6 , 365K) 10.49 (1H, br. s), 8.69 (2H, s), 7.53 (2H, d, J 8.1Hz), 7.25 (2H, d, J 8.4Hz), 6.87 (1H, br. s), 4.62 (1H, m), 3.78 (3H, s), 3.70-3.55 (8H, m), 3.20-3.00 (2H, m); m/z (EI⁺, 70V) 548.

EXAMPLE 34

10 **S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(4-methoxy-6-propyloxy-1,3,5-triazin-2-ylamino)propanoic acid**

Prepared from Intermediate 10 and sodium n-propoxide, followed by

hydrolysis: δ H (DMSO d_6 , 390K) 8.69 (2H, s), 7.53 (2H, d, J 8.4Hz), 7.50 (1H, br. m), 7.27 (2H, d, J 8.3Hz), 4.66 (1H, m), 4.20 (2H, t, J 6.6Hz), 3.82 (3H, s),
15 3.25-3.00 (2H, m), 1.68 (2H, m, J 6.8Hz), 0.93 (3H, t, J 7.4Hz); m/z (EI⁺, 60V) 521.

EXAMPLE 35

20 **S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(4-methoxy-6-phenoxy-1,3,5-triazin-2-ylamino)propanoic acid**

Prepared from Intermediate 10 and sodium phenoxide, followed by

hydrolysis: δ H (DMSO d_6) 10.84 (1H, s), 8.77 (2H, s), 8.25 (1H, m), 7.53 (2H, d, J 8.4Hz), 7.40-7.10 (7H, m), 4.52 (1H, m), 4.41 (1H, m), 3.76 (3H, s),
25 3.10-2.80 (2H, m); m/z (EI⁺, 60V) 555.

EXAMPLE 36

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(4-methoxy-6-n-propylamino-1,3,5-triazin-2-ylamino)propanoic acid

Prepared from Intermediate 10 and n-propylamine, followed by hydrolysis:

5 δ H (DMSO d_6 , 390K) 10.38 (1H, br. s); 8.67 (2H, s), 7.51 (2H, d, J 8.4Hz), 7.25 (2H, d, J 8.4Hz), 6.60 (1H, m), 6.44 (1H, m), 4.68 (1H, m), 3.77 (3H, s), 3.25-3.00 (4H, m), 1.53 (2H, q, J 14.3, 7.2Hz), 0.88 (3H, t, J 7.4Hz); m/z (EI^+ , 60V) 520.

10 **EXAMPLE 37**

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-[4-methoxy-6-(2-hydroxyethylamino)-1,3,5-triazin-2-ylamino]propanoic acid

Prepared from Intermediate 10 and 2-hydroxyethylamine, followed by

hydrolysis: δ H (DMSO d_6 , 350K) 10.57 (1H, s), 8.72 (2H, s), 7.54 (2H, d, J 8.2Hz), 7.27 (2H, d, J 8.3Hz), 6.78-6.68 (1H, m), 4.62 (1H, m), 3.77 (3H, s), 3.50 (2H, d, J 6.0Hz), 3.35 (2H, d, J 5.65Hz), 3.17-3.02 (2H, m); m/z (EI^+ , 60V) 522.

20 **EXAMPLE 38**

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(4-methoxy-6-(4-carboxylpiperidinyl)-1,3,5-triazin-2-ylamino)propanoic acid

Prepared from Intermediate 10 and ethyl piperidine-4-carboxylate, followed

by hydrolysis: δ H (DMSO d_6 , 390K) 10.83 (1H, s), 8.76 (1H, s), 7.53 (2H, d, J 8.3Hz), 7.45 (1H, m), 7.27 (2H, d, J 8.4Hz), 4.55-4.30 (2H, m), 3.72 (3H, s), 3.10-2.80 (2H, m), 1.90-1.75 (2H, m), 1.50-1.30 (2H, m); m/z (EI^+ , 70V) 590.

EXAMPLE 39

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(4-methoxy-6-piperazinyl-1,3,5-triazin-2-ylamino)propanoic acid

Prepared from Intermediate 10 and N-BOC piperazine, followed by hydrolysis and BOC deprotection: δ H (DMSO d_6) 10.58 (1H, s), 8.72 (3H, s), 7.53 (2H, d, J 8.5Hz), 7.24 (2H, d, J 8.5Hz), 6.86 (1H, m), 4.56 (1H, m), 3.78 (3H, s), 3.64 (4H, t, J 5.0Hz), 3.17-3.00 (2H, m), 2.75 (4H, t, J 5.0Hz); m/z (EI⁺, 60V) 547.

EXAMPLE 40

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(4-methoxy-6-(N¹-t-butyloxycarbonylpiperazinyl)-1,3,5-triazin-2-ylamino)propanoic acid

Prepared from Intermediate 10 and N-BOC piperazine, followed by hydrolysis: δ H (DMSO d_6 , 390K) 10.34 (1H, s), 8.67 (2H, s), 7.53 (2H, d, J 7.0Hz), 7.52 (1H, m), 7.27 (2H, d, J 8.4Hz), 6.65 (1H, d, J 7.6Hz), 4.70 (1H, m), 3.81 (3H, s), 3.70 (4H, m), 3.40 (4H, m), 3.30-3.10 (2H, m), 1.46 (9H, s); m/z (EI⁺, 70V) 647.

EXAMPLE 41

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(6-methyl-2-propylsulphonylpyrimidin-4-ylamino)propanoic acid

Prepared from Intermediate 3 and 6-methyl-2,4-di-(n-propylsulphonyl)-pyrimidine, followed by hydrolysis: δ H (DMSO d_6) 10.83 (1H, s), 8.77 (2H, s), 8.27 (1H, d, J 8.0Hz), 7.54 (2H, d, J 8.3Hz), 7.25 (2H, d, J 8.2Hz), 6.58 (1H, s), 4.66 (1H, m), 3.44-2.90 (4H, m), 2.28 (3H, s), 1.67-1.59 (2H, m), 0.96 (3H, t, J 7.4Hz); m/z (EI⁺, 70V) 552.

EXAMPLE 42

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(6-benzylsulphonylpyrimidin-4-ylamino)propanoic acid

Prepared from Intermediate 3 and 4,6-di-(benzylsulphonyl)pyrimidine,
followed by hydrolysis: δ H (DMSO d_6) 10.85 (1H, s), 8.77 (2H, s), 8.62 (1H, s),
8.35 (1H, d, J 7.4Hz), 7.54 (2H, d, J 8.3Hz), 7.30-7.19 (7H, m), 7.02 (1H, s),
4.71 (1H, m), 3.29-2.97 (2H, m), 1.89 (2H, s); m/z (EI⁺, 70V) 586.

EXAMPLE 43

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(6-carboxy-2-propylsulphonylpyrimidin-4-ylamino)propanoic acid

Prepared from Intermediate 3 and methyl 2,6-di-(n-propylsulphonyl)
pyrimidine-4-carboxylate, followed by hydrolysis: δ H (DMSO d_6) 10.85 (1H, s),
8.76 (1H, s), 8.76 (2 H, s), 7.56 (2H, d, J 8.5Hz), 7.35 (1H, s), 7.26 (2H, d, J
8.5Hz), 4.74 (1H, m), 3.74-2.98 (4H, m), 1.70-1.62 (2H, q, J 7.5Hz), 0.97 (3H,
t, J 7.4Hz); m/z (EI⁺, 70V) 582.

EXAMPLE 44

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(6-methyl-4-(propylaminocarbonyl)-pyrimidin-2-ylamino)propanoic acid

Prepared from Intermediate 3 and 2-chloro-4-methyl-6-(n-propylamino
carbonyl) pyrimidine, followed by hydrolysis: δ H (DMSO d_6) 10.82 (1H, s), 8.76
(2H, s), 8.32 (1H, br. s), 7.53 (2H, d, J 8.5Hz), 7.31 (2H, d, J 8.2Hz), 7.00 (1H,
s), 4.75 (1H, m), 3.30-3.10 (4H, m), 2.30 (3H, s), 1.54-1.47 (2H, q, J 14.6,
7.4Hz), 0.87 (3H, t, J 7.3Hz); m/z (EI⁺, 70V) 531.

EXAMPLE 45

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-[6-methyl-4-(diethylaminocarbonyl)-pyrimidin-2-ylamino]propanoic acid

Prepared from Intermediate 3 and 2-chloro-4-methyl-6-(diethylamino-carbonyl) pyrimidine, followed by hydrolysis: δ H (DMSO d_6) 10.34 (1H, s), 8.67 (1H, s), 7.51 (2H, d, J 6.3Hz), 7.27 (2H, d, J 8.3Hz), 6.54 (1H and 1H, together 2H, s), 4.75 (1H, m), 3.35 (4H, m), 3.23-3.07 (2H, m), 2.30 (3H, s), 1.13 (6H, m); m/z (EI^+ , 70V) 545.

EXAMPLE 46

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(6-carboxy-2-iso-butylsulphonylpyrimidin-4-ylamino)propanoic acid

Prepared from Intermediate 3 and methyl 2,6-di-(iso-butylsulphonyl) pyrimidine-4-carboxylate, followed by hydrolysis: δ H (DMSO d_6) 10.84 (1H, s), 8.76 (2H, s), 7.55 (2H, d, J 8.5Hz), 7.35 (1H, s), 7.26 (2H, d, J 8.5Hz), 4.75 (1H, m), 3.39-3.02 (4H, m), 2.14-2.07 (1H, m), 0.98 (6H, d, J 3.3Hz); m/z (EI^+ , 70V) 596.

EXAMPLE 47

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(6-carboxy-2-hexylsulphonylpyrimidin-4-ylamino)propanoic acid

Prepared from Intermediate 3 and methyl 2,6-di-(n-hexylsulphonyl) pyrimidine-4-carboxylate, followed by hydrolysis: δ H (DMSO d_6) 10.84 (1H, s), 8.78 (2H, s), 7.54 (2H, d, J 8.4Hz), 7.36 (1H, s), 7.25 (2H, d, J 8.5Hz), 4.77-4.71 (1H, m), 3.40-3.00 (4H, m), 1.65 (2H, m), 1.36 (2H, m), 1.24 (2H, t, J 3.3Hz), 0.82 (3H, t, J 6.9Hz); m/z (EI^+ , 70V) 624.

EXAMPLE 48

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(4,6-dimethoxy-1,3,5-triazin-2-ylamino)propanoic acid

The title compound was prepared from Intermediate 7 and 2-chloro-4,6-dimethoxy-1,3,5-triazine, followed by hydrolysis: δ H (DMSO d_6) 8.70 (2H, s), 8.10 (1H, d, J 8.0Hz), 7.24 (2H, d, J 8.3Hz), 6.95 (2H, d, J 8.3Hz), 5.18 (2H, s), 4.52 (1H, m), 3.81 (3H, s), 3.80 (3H, s), 3.15-2.90 (2H, m); m/z (EI⁺, 60V) 480.

EXAMPLE 49

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(4,6-propyloxy-1,3,5-triazin-2-ylamino)propanoic acid

Prepared from Intermediate 3 and 2-chloro-4,6-di-n-propoxy-1,3,5-triazine, followed by hydrolysis: δ H (DMSO d_6) 10.84 (1H, br. s), 8.77 (2H, s), 8.00 (1H, d, J 7.8Hz), 7.54 (2H, d, J 8.4Hz), 7.30 (2H, d, J 8.4Hz), 4.52 (1H, m), 3.15-2.80 (2H, m), 1.64 (4H, m), 0.89 (6H, m); m/z (EI⁺, 60V) 549.

EXAMPLE 50

S-Methyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)-phenyl]-2-(N-methyl-4,6-dimethoxy-1,3,5-triazin-2-ylamino)propionate

The title compound (350mg, 80%) was prepared in an analogous manner to the compound of Example 1 starting from S-Methyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)-phenyl]-2-(N-methylamino)propionate hydrochloride (500mg 1.19mmol): δ H (CDCl₃) 8.55 (2H, s), 7.80 (1H, s), 7.50 (2H, d, J 8.0Hz), 7.20 (2H, d, J 8.0Hz), 5.40 (1H, m), 4.00 (3H, s), 3.95 (3H, s), 3.75 (3H, s), 3.50 (2H, m), 3.10 (3H, s); m/z (EI⁺, 70V) 521.

EXAMPLE 51

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(N-methyl-4,6-dimethoxy-1,3,5-triazin-2-ylamino)propanoic acid

The title compound was prepared from the compound of Example 50 by the method of Example 2: δ H (DMSO d_6) 10.81 (s, 1H), 8.77 (2H, s), 7.51 (2H, d, J 8.5Hz), 7.23 (2H, d, J 8.5Hz), 5.34 (1H, m), 3.81 (3H, s), 3.80 (3H, s), 3.22 (2H, m), 2.92 (3H, s); m/z (EI⁺, 70V) 507.

EXAMPLE 52

R-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)-phenyl]-2-(4,6-dimethoxy-1,3,5-triazin-2-ylamino)propanoic acid

The title compound was prepared from R-ethyl-3-[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl]-2-aminopropionate hydrochloride in an analogous fashion to the compounds of Examples 1 and 2: δ H (DMSO d_6) 10.84 (s, 1H), 8.72 (2H, s), 8.15 (1H, d, J 7.8Hz), 7.55 (2H, d, J 8.4Hz), 7.30 (2H, d, J 8.4Hz), 4.55 (1H, m), 3.80 (3H, s), 3.78 (3H, s), 3.12 (1H, dd, J 13.8, 4.5Hz), 3.01 (1H, dd, J 13.8, 10.3Hz); m/z (EI⁺, 70V) 493.

EXAMPLE 53

S-Ethyl 3-[4-N-methyl-(3,5-dichloropyrid-4-ylcarboxamido)-phenyl]-2-(N-methyl-4,6-dimethoxy-1,3,5-triazin-2-ylamino)propionate

To a solution of the ethyl ester analogue of the compound of Example 50 (310mg, 0.59mmol) in DMF (10ml) was added cesium carbonate (388mg, 1.18mmol) and iodomethane (390 μ l, 590mmol) and the mixture was stirred at room temperature for 16h. The reaction was concentrated *in vacuo* and extracted with ethyl acetate (50ml). The organics were washed with water (2 x 50ml), dried (Na₂SO₄) and evaporated. The residue was chromatographed (silica; EtOAc/Hexane 1:1) to give the title compound as a white solid (100mg, 31 %):

δ H (CDCl₃) 8.35 (1H, d), 7.20 (2H, d), 7.00 (2H, d), 5.10 (1H, m), 4.10 (2H, m), 4.00 (3H, s), 3.90 (3H, s), 3.49 (3H, s), 3.40 (1H, m), 3.30 (1H, m), 2.80 (3H, m), 1.20 (3H, m); m/z (EI⁺, 70V) 549.

5 **EXAMPLE 54**

S-3-[4-N-Methyl-(3,5-dichloropyrid-4-ylcarboxamido)-phenyl]-2-(N-methyl-4,6-dimethoxy-1,3,5-triazin-2-ylamino)propanoic acid

The title compound was prepared from the compound of Example 53 in an analogous manner to Example 2: δ H (DMSO d₆) 8.37, (1H, s), 8.32 (1H, s), 7.18 (2H, d, J 8.4Hz), 7.11 (2H, d, J 8.4Hz), 5.24 (1H, dd, J 11.0, 5.3Hz), 3.85 (6H, s), 3.36 (3H, s), 3.19 (2H, m), 2.77 (3H, s); m/z (EI⁺ J 70V) 521.

10 **EXAMPLE 55**

S-Ethyl[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl]-2-[(6-chloropyridazin-3-yl)amino]-propionate

15 A solution of the compound of Intermediate 3 (420mg, 1mmol) in CH₃CN (2ml) was treated with DIPEA (0.36ml, 2.1 mmol) and 3,6dichloropyridazine (164mg, 1.1 mmol) and heated to reflux temperature for 36h. The solvent was removed *in vacuo*; the residue re-dissolved in EtOH (2.5 ml) and a further portion of pyridazine (82mg, 0.55mmol) and DIPEA (0.18ml, 1.1 mmol) were added. 20 The resulting mixture was heated to reflux for 48h, the solvent was removed *in vacuo* and the residue was dissolved in EtOAc (20ml) and washed with 10% citric acid (2 x 10ml), NaHCO₃ (2 x10ml) and brine (10ml), dried (MgSO₄) and the solvent removed *in vacuo*. The product was purified by chromatography (silica 25 2-5% MeOH/DCM) to give the title compound as a white solid (80mg, 16%): δ H (DMSO d₆) 10.85 (1H, s), 8.77 (2H, s), 7.56 (2H, d, J 8.5Hz), 7.50 (1H, d, J 7.7Hz), 7.39 (1H, d, J 9.3Hz), 7.26 (2H, d, J 8.5Hz), 7.02 (1H, d, J 9.3Hz), 4.20

(1H, m), 4.06 (2H, q, J 7.1Hz), 3.10 (2H, m), 1.12 (3H, t, J 7.1Hz); m/z (EI^+ , 60V) 494.

EXAMPLE 56

S-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-[(6-chloropyridazin-3-yl)amino]propanoic acid

The title compound (50mg, 79%) was prepared from the compound of Example 55 by hydrolysis in a similar manner to Example 2 (67mg, 0.14mmol): δH (DMSO d_6) 10.84 (1H, s), 8.77 (2H, s), 7.55 (2H, d, J 8.5Hz), 7.37 (1H, d, J 9.3Hz), 7.35 (1H, m), 7.26 (2H, d, J 8.5Hz), 7.01 (1H, d, J 9.3Hz), 4.67 (1H, m), 3.17 (1H, dd, J 18.8, 5.0Hz), 2.96 (1H, dd, J 22.6, 8.9Hz); m/z (EI^+ , 60V) 466.

EXAMPLE 57

S-Ethyl-3-(4-nitrophenyl)-2-[(4,6-dimethoxy-1,3,5-triazin-2-yl)amino]propionate

2-Chloro-4,6-dimethoxy-1,3,5-triazine (8.05g, 45.8mmol) was added to a solution of (S)-4-nitrophenylalanine ethyl ester hydrochloride (5.0g, 38.2mmol) and DIPEA (13.6ml, 78.3mmol) in acetonitrile (80ml) and the reaction was stirred at room temperature for 16h, concentrated *in vacuo* and the residue partitioned between EtOAc (100ml) and $NaHCO_3$ solution (100ml). The organic layer was washed with 10% citric acid solution (100ml), $NaHCO_3$ solution (100ml) and water (100ml), dried ($MgSO_4$) and concentrated *in vacuo*. The crude product was purified by chromatography (silica; EtOAc/Hexane 1:1) to give the title compound (6.66g, 97%): δH ($CDCl_3$) 8.10 (2H, d, J 9.0Hz), 7.30 (2H, d, J 9.0Hz), 6.10 (1H, m), 5.0 (1H, m), 4.1 (2H, q, J 7.1Hz), 3.92 (3H, s), 3.90 (3H, s), 3.30 (2H, m), 1.25 (3H, t, J 7.1Hz); m/z ($E I^+$, 70V) 378.

EXAMPLE 58

S-Ethyl-3-(4-aminophenyl)-2-[(4,6-dimethoxy-1,3,5-triazin-2-yl)aminol]propionate

Palladium (10% on charcoal) (660mg) was added to a solution of the compound of Example 57 (6.66g, 24.3mmol) in EtOH (100ml) and stirred under an atmosphere of hydrogen for 16h. The catalyst was removed by filtration and the solution concentrated *in vacuo* to give the title compound as a pink solid (5.26g, 86%) which was used without further purification: δ H (CDCl₃) 6.90 (2H, d), 6.60 (2H, d), 5.75 (1H, d), 4.90 (1H, m), 4.10 (2H, q), 3.95 (3H, s), 3.90 (3H, s), 3.10 (2H, m), 1.30 (3H, t); m/z (ES⁺, 70V) 348.

EXAMPLE 59

S-Ethyl-3-[4-(2,6-dichlorophenylcarboxamido)phenyl]-2-[(4,6-dimethoxy-1,3,5-triazin-2-yl)aminol]propionate

2,6-Dichlorobenzoyl chloride (0.22ml, 1.5mmol) was added to a solution of the compound of Example 58 (0.50g, 1.4mmol) and NMM (0.17ml, 1.5mmol) in DCM (10ml). The reaction was stirred at room temperature for 72h, then partitioned between DCM (50ml) and NaHCO₃ solution (50ml). The organic layer was washed with 10% citric acid solution (50ml), NaHCO₃ solution (50ml) and water (50ml), dried (MgSO₄) and concentrated *in vacuo* to give the title compound as a pink solid (0.61g, 82%) which was used without further purification: δ H (CDCl₃) 7.60 (2H, d), 7.30 (3H, m), 7.10 (2H, d), 5.90 (1H, d), 4.90 (1H, m), 4.20 (2H, m), 3.90 (3H, s), 3.89 (3H, s), 3.20 (2H, m), 1.25 (3H, m); m/z (EI⁺, 70V) 520.

EXAMPLE 60

S-3-[4-(2,6-Dichlorophenylcarboxamido)phenyl]-2-[(4,6-dimethoxy-1,3,5-triazin-2-yl)amino]propanoic acid

The title compound was prepared by hydrolysis in a similar manner to Example 2 from the compound of Example 59: δ H (DMSO d_6) 10.70 (1H, s), 8.15 (2H, d), 7.50 (6H, m), 7.25 (2H, d), 4.50 (1H, m), 3.75 (6H, m), 3.00 (2H, m); m/z (EI⁺, 60V) 492.

EXAMPLE 61

S-Ethyl-3-[4-(2-fluoro-6-trifluoromethylphenylcarboxamido)phenyl]-2-[(4,6-dimethoxy-1,3,5-triazin-2-yl)amino]propionate

The title compound was prepared in an analogous manner to the compound of Example 59 using 2-fluoro-6-trifluoromethylbenzoyl chloride: δ H (CDCl₃) 7.6 (5H, m), 7.40 (1H, m), 7.10 (2H, d, J 8.0Hz), 5.90 (1H, d, J 6.0Hz), 5.0 (1H, m), 4.2 (2H, q), 3.90 (2 x 3H, s), 3.20 (2H, m), 1.25 (3H, t); m/z (EI⁺, 70V) 538.

EXAMPLE 62

S-3-[4-(2-Fluoro-6-trifluoromethylphenylcarboxamido)phenyl]-2-[(4,6-dimethoxy-1,3,5-triazin-2-yl)amino]propanoic acid

The title compound was prepared from the compound of Example 61 by hydrolysis in a similar manner to Example 2: δ H (DMSO d_6) 8.10 (2H, m), 7.80 (3H, m), 7.50 (2H, m), 7.30 (2H, m), 4.50 (1H, m), 3.70 (6H, s), 3.00 (2H, m); m/z (EI⁺, 70V) 510.

EXAMPLE 63

S-Ethyl-3-[4-(4,6-dimethoxy-1,3,5-triazin-2-yl)aminophenyl]-2-[(4,6-dimethoxy-1,3,5-triazin-2-yl)amino]propionate

2-Chloro-4,6-dimethoxy-1,3,5-triazine (0.30g, 1.7mmol) was added to a solution of the compound of Example 58 (0.50g, 1.4mmol) and DIPEA (0.60ml, 3.2mmol) in CH₃CN (10ml). The reaction was stirred at room temperature for 72h, then concentrated *in vacuo*, partitioned between EtOAc (50ml) and NaHCO₃ solution (50ml). The organic layer was washed with 10% citric acid solution (50ml), NaHCO₃ solution (50ml) and water (50ml), dried (MgSO₄) and concentrated *in vacuo* to give the title compound as an off white solid (0.23g, 32%) which was used without further purification: δ H (CDCl₃) 7.5 (2H, d, J 9.0Hz), 7.10 (2H, d, J 9.0Hz), 6.05 (1H, d, J 6.0Hz), 5.0 (1H, m), 4.15 (2H, q), 4.05 (6H, s), 3.95 (6H, s), 3.20 (2H, m), 1.25 (3H, m); m/z (EI⁺, 70V) 487.

EXAMPLE 64

S-3-[4-(4,6-Dimethoxy-1,3,5-triazin-2-yl)aminophenyl]-2-[(4,6-dimethoxy-1,3,5-triazin-2-yl)amino]propanoic acid

The title compound was prepared from the compound of Example 63 by hydrolysis in a similar manner to Example 2: δ H (DMSO d₆) 10.00 (1H, s), 8.20 (2H, d), 7.55 (2H, d), 7.20 (2H, d), 4.55 (1H, m), 3.90 (6H, s), 3.80 (6H, s), 3.00 (2H, m); m/z (EI⁺, 70V) 459.

EXAMPLE 65

S-Ethyl 3-[4-(4,6-dimethoxy-1,3,5-triazin-2-yl)phenoxy]-2-[(4,6-dimethoxy-1,3,5-triazin-2-yl)amino]propionate

A solution of Intermediate 11 (0.50g, 1.43 mmol) in DMF (10ml) was treated with caesium carbonate (0.94g, 2.86mmol) and stirred at room temperature for 15min. 2-Chloro-4,6-dimethoxy-1,3,5-triazine (0.25g, 1.43mmol) was added

and the reaction stirred for 16h then concentrated *in vacuo*, and partitioned between EtOAc (50ml) and water (50ml). The organic layer was separated, dried (MgSO₄) and concentrated *in vacuo* to give the title compound as an off-white solid (0.47g, 67%): δ H (DMSO d₆) 7.25 (2H, d, J 7.0Hz), 7.20 (2H, d, J 7.0Hz), 5.90 (1H, d), 5.00 (1H, m), 4.20 (2H, m), 4.00 (12H, s), 3.20 (2H, m), 1.20 (3H, t, J 7.1Hz); m/z (EI⁺, 70V) 488.

EXAMPLE 66

S-3-[4-(4,6-Dimethoxy-1,3,5-triazin-2-yl)phenoxy]-2-[(4,6-dimethoxy-1,3,5-triazin-2-yl)amino]propanoic acid

The title compound was prepared from the compound of Example 65, by hydrolysis in a similar manner to Example 2: δ H (DMSO d₆) 8.00 (1H, s), 7.35 (2H, d, J 8.0Hz), 7.10 (2H, d, J 8.0Hz), 4.50 (1H, m), 3.85 (6H, s), 3.79 (6H, s), 3.77 (6H, s), 3.20 (2H, m); m/z (EI⁺, 70V) 460.

EXAMPLE 67

S-Ethyl 3-[4-(2,6-dichlorobenzyl)phenoxy]-2-[(4,6-dimethoxy-1,3,5-triazin-2-yl)amino]propionate

A solution of Intermediate 11 (0.50g, 1.43 mmol) in DMF (10ml) was treated with caesium carbonate (0.948, 2.86mmol) and stirred at room temperature for 15min. 2,6-Dichlorobenzyl bromide (0.38g, 1.58mmol) was added and the reaction stirred for 16h then concentrated *in vacuo*, and partitioned between EtOAc (50ml) and water (50ml). The organic layer was separated, washed with water (2 x 50ml), dried (MgSO₄) and concentrated *in vacuo*. The residue was purified by chromatography (silica; EtOAc/Hexane 1:1) to give the title compound as an oil (0.26g, 36%): δ H (DMSO d₆) 7.45 (1H, m), 7.40 (1H, m), 7.35 (1H, m), 7.10 (2H, d), 6.90 (2H, d), 5.8 (1H, d), 5.25 (2H, s), 4.10 (2H, m), 3.90 (6H, s), 3.10 (2H, m), 1.3 (3H, m); m/z (EI⁺, 70V) 507.

EXAMPLE 68

S-3-[4-(2,6-Dichlorobenzyl)phenoxy]-2-[(4,6-dimethoxy-1,3,5-triazin-2-yl)amino]propanoic acid

The title compound was prepared from the compound of Example 67, by hydrolysis in a similar manner to Example 2: δ H (DMSO d_6) 8.10 (1H, d), 7.50 (2H, m), 7.45 (1H, m), 7.25 (2H, d, J 8.0Hz), 6.95 (2H, d, J 8.0Hz), 5.15 (2H, m), 4.50 (1H, m), 3.80 (3H, s), 3.75 (3H, s), 3.00 (2H, m); m/z (EI^+ , 70V) 479.

EXAMPLE 69

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-[3-(propylsulphonyl)pyrazin-2-ylamino]propanoic acid

The title compound was prepared in an analogous manner to the compound of Example 1 starting from Intermediate 3 and Intermediate 12, followed by hydrolysis: δ H (DMSO d_6) 10.86 (1H, s), 8.77 (2H, s), 8.40 (1H, d, J 2.3Hz), 7.99 (1H, d, J 2.3Hz), 7.55 (2H, d, J 8.5Hz), 7.37 (1H, d, J 7.0Hz), 7.18 (2H, d, J 8.5Hz), 4.80 (1H, br. q), 3.38-3.22 (3H, m), 3.10 (1H, dd, J 13.9, 7.0Hz), 1.55-1.46 (2H, m), 0.88 (3H, t, J 7.4Hz); m/z (EI^+ , 70V) 538.

EXAMPLE 70

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-[3-chloropyrazin-2-ylamino]propanoic acid

The title compound was prepared in an analogous manner to the compound of Example 5 starting from Intermediate 3 and 2,3dichloropyrazine, followed by hydrolysis: δ H (DMSO d_6) 12.81 (1H, br. s), 10.83 (1H, s), 8.77 (2H, s), 7.99 (1H, d, J 2.7Hz), 7.61 (1H, d, J 2.7Hz), 7.54 (2H, d, J 8.5Hz), 7.28 (2H, d, J 8.5Hz), 6.87 (1H, d, J 7.9Hz), 4.68-4.61 (1H, m), 3.22 (2 H, m); m/z (EI^+ , 70V) 466.

EXAMPLE 71

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-[6-chloropyrazin-2-ylamino]propanoic acid

The title compound was prepared in an analogous manner to the compound of Example 5 starting from Intermediate 3 and 2,6dichloropyrazine, followed by hydrolysis: δ H (DMSO d_6) 12.82 (1H, br: s), 10.84 (1H, s), 8.77 (2 H, s), 7.97 (1H, s), 7.84 (1H, d, J 8.0Hz), 7.72 (1H, s), 7.54 (2H, d, J 8.5Hz), 7.27 (2H, d, J 8.5Hz), 4.51 (1H, ddd, J 8.9, 8.0, 4.9Hz), 3.15 (1H, dd, J 13.9, 4.4Hz), 2.96 (1H, dd, J 13.9, 9.1Hz); m/z (EI⁺, 70V) 466.

EXAMPLE 72

S-Ethyl 3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-[3-chloroquinoxalin-2-ylamino]propionate

The title compound was prepared in an analogous manner to the compound of Example 5 starting from Intermediate 3 and 2,3-dichloroquinoxaline. The product contains some ethoxyethylester as a result of transesterification in the ethoxyethanol used as solvent in this case: δ H (DMSO d_6) 10.38 (1H, s), 8.76 (2H, s), 7.76 (1H, d, J 8.2Hz), 7.65-7.41 (6H, m), 7.32 (2H, d, J 8.4Hz), 4.82-4.75 (1H, m), 4.17-4.06 (2H, m), 3.40-3.20 (2H, m), 1.14 (3H, t, J 7.1Hz); m/z (ES⁺, 70V) 544. For the ethoxyethyl ester: δ H (DMSO d_6) 3.47-3.42 (m), 0.97 (3H, t, J 7.0Hz); m/z (EI⁺, 70V) 588.

EXAMPLE 73

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-[3-chloroquinoxalin-2-ylamino]propanoic acid

The title compound was prepared from the compound of Example 72 by hydrolysis: δ H (DMSO d_6) 12.84 (1H, br. s), 10.81 (1H, s), 8.76 (2H, s), 7.76 (1H, d, J 8.2Hz), 7.63-7.61 (2 H, m), 7.54 (1H, d, J 8.5Hz), 7.46-41 (1H, m), 7.33-7.25 (3 H, m), 4.86-4.79 (1H, m), 3.30-3.26 (2 H, m); m/z (EI⁺, 70V) 516.

EXAMPLE 74

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-[3-phenoxyquinoxalin-2-ylamino]propanoic acid

The title compound was prepared in an analogous manner to the compound of Example 5 starting from Intermediate 3 and Intermediate 14 followed by hydrolysis: δ H (DMSO d_6) 12.90 (1H, br. s), 10.83 (1H, s), 8.76 (2H, s), 7.57-7.23 (14H, m), 4.91-4.84 (1H, m), 3.30 (2H, br. d J 6.6Hz); m/z (EI⁺, 70V) 574.

EXAMPLE 75

S-Ethyl 3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-[3-morpholinoquinoxalin-2-ylamino]propionate

A mixture of the compound of Example 73 (300mg, 0.55mmol), morpholine (58 μ l, 0.66mmol) and DIPEA (192 μ L, 1.1 mmol) in ethoxyethanol (2ml) was heated at reflux overnight. The solvent was removed *in vacuo*. The residue was dissolved in DCM, washed with dil. HCl, dried (Na₂SO₄) and evaporated *in vacuo*. Column chromatography (silica; EtOAc/Hexane 6:4) gave the title compound (280mg) as a brown oil, which contains some of the corresponding ethoxyethyl ester, from transesterification: δ H (DMSO d_6) 10.84 (1H, s), 8.77 (2H, s), 7.61-7.27 (8H, m), 6.70 (1H, d, J 7.8Hz), 4.75 (1H, m),

4.21-4.07 (2H, m and ethoxyethyl ester), 3.86-3.80 (2H, m), 3.71-3.66 (2H, m), 3.50 (m, ethoxyethyl ester); 3.30 (2H, m), 3.12-3.17 (2H, m), 2.97-2.91 (2H; m), 1.16 (t, J 7.1Hz) and 1.00 (t, J 7.0Hz) together (3H); m/z (EI^+ , 70V) 595, 639 (ethoxyethyl ester).

5

EXAMPLE 76

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-[3-morpholinoquinoxalin-2-ylamino]propanoic acid

10 The title compound was prepared by starting from the compound of Example 75 followed by hydrolysis: δH (DMSO d_6) 10.83 (1H, s), 8.76 (2H, s), 7.61-7.26 (8H, m), 6.55 (1H, d, J 7.8Hz), 4.74 (1H, m), 3.84-3.79 (2H, m), 3.69-3.64 (2H, m), 3.30-3.20 (2H, m), 3.20-3.10 (2H, m), 2.93-2.88 (2H, m); m/z (EI^+ , 70V) 567.

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EXAMPLE 77

Ethyl 2-[4-(3,5-dichloropyrid-4-ylcarboxamido)benzyl]-3-[6-(propylsulphonyl)-pyrimidin-4-ylamino]propionate

20 A mixture of Intermediate 19 (440mg, 1.11 mmol) Intermediate 13 (271 mg, 0.93mmol) and DIPEA (193 μ l, 1.11 mmol) in CH_3CN (5ml) was stirred at room temperature for 2h. The solvent was removed *in vacuo* and the residue dissolved in DCM, washed with dil. HCl, dried (Na_2SO_4) and evaporated *in vacuo*. Column chromatography (silica; MeOH/DCM 5:95) gave the title compound as a colourless oil (400mg): δH (DMSO d_6) 10.85 (1H, s), 8.78 (2H, s), 8.30 (1H, br. t, J 5.7Hz), 7.55 (2H, d, J 8.5Hz), 7.20 (2H, d, J 8.5Hz), 7.10 (1H, s), 3.97 (2H, q, J 7.4Hz), 3.60 (2H, br. m), 3.36-3.27 (4H, m), 2.99, (1H, m), 1.58 (2H, sext J 7.5Hz), 1.03 (3H, t, J 7.1Hz), 0.93 (3H, t, J 7.4Hz): m/z (EI^+ , 70V) 580.

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EXAMPLE 78

2-[4-(3,5-Dichloropyrid-4-ylcarboxamido)benzyl]-3-[6-(propylsulphonyl)-pyrimidin-4-ylamino]propanoic acid

The title compound was prepared by hydrolysis from the compound of Example 77 in a similar manner to Example 2.: δ H (DMSO d_6) 12.38 (1H, br. s), 10.85 (1H, s), 8.78 (2H, s), 8.57 (1H, s), 8.30 (1H, br, m), 7.55 (2H, d, J 8.5Hz), 7.21 (2H, d, J 8.5Hz), 7.12 (1H, s), 3.55 (2H, br. m), 3.33-3.29; 4H, m), 2.95-2.83, (1H, m), 1.59 (2H, sext, J 7.6Hz), 0.94 (3H, t, J 7.4Hz): m/z (EI⁺, 70V) 552.

EXAMPLE 79

Ethyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl]-2-(3-benzyloxybenzeneamino)propionate

A solution of Intermediate 20 (500mg, 1.3mmol), 3-benzyloxyaniline (1.1 equiv) and rhodium (II) acetate dimer (5 mol%) in anhydrous toluene (20ml) were stirred at 80° for 7h. The mixture was cooled and the volatiles removed *in vacuo*. The residue was purified by chromatography (silica; 1% MeOH/DCM) to give the title compound (500mg, 70%): δ H (CDCl₃) 3.50 (2H, s), 8.06 (1H, br. s), 7.49 (2H, d, J 8.5Hz), 7.43-7.26 (6H, m), 7.14 (2H, d, J 8.5Hz), 7.05 (1H, t, J 8.5Hz), 6.37 (1H, d, J 7.3Hz), 6.24 (2H, m), 3.00 (2H, s), 4.40-4.08 (4H, m), 3.13 (1H, dd, J 13.4, 7Hz), 3.02 (1H, dd, J 13.4, 5.9Hz), 1.20 (3H, t, J 7.2Hz): m/z (EI⁺, 70V) 564.

EXAMPLE 80

Ethyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl]-2-(3-propylthiobenzeneamino) propionate

The title compound was prepared by a similar procedure to the compound of Example 79, starting from 3-propylthioaniline: δ H (CDCl₃) 8.56 (2H, s),

7.72-7.58 (2H, m), 7.53 (2H, d, J 8.5Hz), 7.10 (2H, d, J 8.4Hz), 7.04 (1H, t, J 7.9Hz), 6.68 (1H, d, J 7.9Hz), 6.57 (1H, s), 6.42 (1H, d), 4.40-4.10 (3H, m), 3.25-3.07 (2H, m), 2.83 (2H, t, J 7.3Hz), 1.63 (2H, m), 1.21 (3H, t, J 6.8Hz), 1.01 (3H, t, J 7.4Hz): m/z (EI⁺, 70V) 532.

5

EXAMPLE 81

Ethyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl]-2-(4-ethoxycarbonylbenzeneamino) propionate

10

The title compound was prepared by a similar procedure to the compound of Example 79, starting from ethyl 4-aminobenzene carboxylate: δ H (CDCl₃) 8.58 (2H, s), 7.85 (2H, d, J 8.8Hz), 7.56-7.51 (3H, m), 7.15 (2H, d, 8.5Hz), 6.56 (1H, d, J 8.8Hz), 4.70-4.60 (1H, br. m), 4.55-4.45 (1H, br. m), 4.32 (2H, q, J 7.2Hz), 4.16 (2H, q, J 7.1Hz), 3.30-3.14 (2H, m), 1.33 (3H, t, J 7.2Hz), 1.23 (3H, t, J 7.1Hz): m/z (EI⁺, 70V) 530.

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EXAMPLE 82

Ethyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl]-2-(3-propylsulphonylbenzeneamino) propionate

20

The title compound was prepared by oxidation of the compound of Example 80 with mCPBA: δ H (CDCl₃) 8.47 (2H, s), 8.36 (1H, br. s), 7.51 (2H, d, J 8.5Hz), 7.30 (1H, t, J 7.9Hz), 7.12 (2H, d, J 8.4Hz), 7.01 (1H, m), 6.78 (1H, m), 4.61 (1H, br. m), 4.40 (1H, br. m), 4.10 (2H, q, J 5.9Hz), 3.15 (1H, dd, J 13.9, 5.6Hz), 3.05 (1H, dd, J 13.9, 6.3Hz), 2.95 (2H, m), 1.61 (2H, m), (3H, t, J 7.2Hz), 0.94 (3H, t, J 7.4Hz): m/z (EI⁺, 70V) 564.

25

EXAMPLE 83

Ethyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl]-2-(3-propylsulphinylbenezeneamino) propionate

The title compound was prepared by oxidation of the compound of Example 80 with mCPBA: δ H (CDCl₃) 9.11 (1H, d, J 8.3Hz), 8.44 (2H, s), 7.56 (2H, d, J 8.0Hz), 7.21 (1H, t, J 7.8Hz), 7.12 (2H, m), 6.80-6.64 (3H, m), 4.65-4.35 (2H, br. m), 4.10 (2H, q, J 7.1Hz), 3.20-3.00 (2H, m), 2.70-2.50 (2H, m), 1.80-1.50 (2H, m), (3H, t, J 8.7Hz), 0.99 (3H, t, J 7.5Hz): m/z (EI⁺, 70V) 548.

EXAMPLE 84

Ethyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl]-3-(4-ethylacetatobenezeneamino) propionate

The title compound was prepared by a similar procedure to the compound of Example 79, starting from ethyl 4-aminobenzene acetate: δ H (CDCl₃) 8.57 (2H, s), 7.81 (2H, d, J 8.5Hz), 7.17 (2H, d, J 8.5Hz), 7.06 (2H, d, J 8.8Hz), 6.55 (2H, d, J 8.6Hz), 4.30 (1H, br. m), 4.10 (4H, m), 3.48 (2H, s), 3.25-3.00 (2H, m), 1.20 (6H, m): m/z (EI⁺, 70V) 544.

EXAMPLE 85

Ethyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl]-2-(3-acetylbenzeneamino) propionate

The title compound was prepared by a similar procedure to the compound of Example 79, starting from 3-amino acetophenone: δ H (CDCl₃) 8.56 (2H, s), 7.65 (1H, br. m), 7.40-7.10 (5H, m), 6.80 (1H, m), 4.50-4.30 (2H, br. m), 4.16 (2H, q, J 7.2Hz), 3.25-3.10 (2H, m), 2.54 (3H, s), 1.22 (3H, t, J 7.2Hz): m/z (EI⁺, 70V).

EXAMPLE 86

Ethyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl]-2-(2-chloro-pyridine-3-amino) propionate

The title compound was prepared by a similar procedure to the compound of Example 79, starting from 3-amino-2-chloro-pyridine: δ H (CDCl₃) 8.56 (2H, s), 7.78 (1H, br. s), 7.70 (1H, d, J 4.7Hz), 7.56 (2H, d, J 8.5Hz), 7.20 (2H, d, J 8.5Hz), 7.04 (1H, m), 6.78 (1H, m, J 8.0, 1.3Hz), 4.87 (1H, br. m), 4.40-4.15 (3H, m), 3.18 (1H, dd, J 14.0, 5.7Hz), 3.11 (1H, dd, J 13.7, 6.6Hz), 1.23 (3H, t, J 7.1Hz): m/z (EI⁺, 70V) 493.

EXAMPLE 87

Ethyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl]-2-(3-benzoylbenzeneamino) propionate

The title compound was prepared by a similar procedure to the compound of Example 79, starting from 3-amino benzophenone: δ H (CDCl₃) 8.55 (2H, s), 7.72 (2H, d, J 8.5Hz), 7.70-7.40 (6H, m), 7.30-7.00 (6H, m), 6.80 (1H, m), 4.40 (1H, br. m), 4.15 (2H, q, J 7.2Hz), 3.40-3.20 (2H, m), 1.20 (3H, t, J 7.2Hz): m/z (EI⁺, 70V) 562.

EXAMPLE 88

Ethyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl]-2-(3-ethoxycarbonylbenzeneamino) propionate

The title compound was prepared by a similar procedure to the compound of Example 79, starting from ethyl 3-aminobenzoate: δ H (CDCl₃) 8.44 (2H, s), 7.50 (2H, d, J 8.4Hz), 7.35 (1H, d, J 7.7Hz), 7.30-7.10 (4H, m), 6.77 (1H, m), 4.40 (1H, br. s), 4.31 (2H, q, J 7.2Hz), 4.09 (2H, m), 3.25-3.00 (2H, m), 1.33 (3H, t, J 7.2Hz), 1.21 (3H, t, J 7.2Hz): m/z (EI⁺, 70V) 530.

EXAMPLE 89

Ethyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl]-2-(5-chloro-4-propylthiopyridine-2-amino) propionate

The title compound was prepared by a similar procedure to the compound of Example 79, starting from Intermediate 23: δ H (CDCl₃) 8.53 (2H, s), 8.11 (1H, s), 7.87 (1H, s), 7.54 (2H, d, J 8.4Hz), 7.19 (2H, d, J 8.4Hz), 6.17 (1H, s), 4.80 (1H, br. m), 4.21 (2H, q, J 7.1Hz), 3.21 (1H, dd, J 14.0, 5.5Hz), 3.09 (1H, dd, J 14.0, 5.7Hz), 2.80 (2H, t, J 7.2Hz), 1.74 (2H, m), 1.30 (3H, t, J 7.1Hz), 1.07 (3H, t, J 7.3Hz): m/z (EI⁺, 70V) 568.

EXAMPLE 90

Ethyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl]-2-(5-chloro-4-propylsulphonylpyridine-2-amino) propionate

The title compound was prepared by oxidation of the compound of Example 89 with mCPBA: δ H (CDCl₃) 8.55 (2 H, s), 7.94 (2 H, m), 7.52 (2 H, d, J 8.4Hz), 7.12 (2H, m), 6.82 (1H, d), 4.90 (1H, m), 4.20 (2H, m), 3.40-3.00 (3H, m), 2.90-2.70 (1H, m), 2.00-1.60 (2H, m), 1.25 (3H, t, J 7.2Hz), 1.07 (3H, t, J 7.2Hz): m/z (EI⁺, 70V) 584.

EXAMPLE 91

Ethyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl]-2-(5-chloro-4-propylsulphonylpyridine-2-amino) propionate

The title compound was prepared by oxidation of the compound of Example 89 with m-chloroperoxybenzoic acid: δ H (CDCl₃) 8.56 (2H, s), 8.19 (1H, s), 7.63 (1H, br. s), 7.51 (2H, d, J 8.4Hz), 7.17 (2H, d, J 8.4Hz), 7.14 (1H, s), 5.34 (1H, br. m), 4.21 (2H, q, J 7.2Hz), 3.30 (2H, t, J 7.9Hz), 3.35-3.10 (2H, m), 1.70 (2H, m), 1.29 (3H, t, J 7.2Hz), 1.01 (3H, t, J 7.5Hz): m/z (EI⁺, 70V) 598.

EXAMPLE 92

Ethyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl]-2-(5-chloropyridine-2-amino) propionate

The title compound was prepared by a similar procedure to the compound of Example 79, starting from 2-amino-5-chloro-pyridine: δ H (CDCl₃) 8.56 (2H, s), 8.03 (1H, m), 7.59 (1H, m), 7.15 (2H, d, J 8.5Hz), 6.37 (1H, d, J 8.9Hz), 4.84 (1H, br. m), 4.15 (2H, q, J 7.2Hz), 3.30-3.10 (2H, m), 1.20 (3H, t, J 7.2Hz).

EXAMPLE 93

Ethyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl]-2-(4-propylthiopyridine-2-amino) propionate

The title compound was prepared by a similar procedure to the compound of Example 79, starting from 2-amino-4-propylthio-pyridine: δ H (CDCl₃) 8.51 (2H, s), 8.40 (1H, br. s), 7.81 (1H, d, J 5.6Hz), 7.49 (2H, d, J 8.5Hz), 7.13 (2H, d, J 8.5Hz), 6.44 (1H, dd, J 5.6, 1.6Hz), 6.19 (1H, d, J 1.2Hz), 4.95-4.72 (2H, m), 4.15 (2H, q, J 7.1Hz), 3.30-3.05 (2H, m), 2.80 (2H, t, J 7.4Hz), 1.70 (2H, m), 1.22 (3H, t, J 7.1Hz), 1.01 (3H, t, J 7.4Hz).

EXAMPLE 94

Ethyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl]-2-(4-propylsulphonylpyridine-2-amino) propionate

The title compound was prepared by oxone oxidation of the compound of Example 93: δ H (CDCl₃) 8.56 (2H, s), 8.23 (1H, d, J 5.3Hz), 7.68 (1H, br. m), 7.53 (2H, d, J 8.5Hz), 7.20 (2H, d, J 8.5Hz), 6.96 (1H, m), 6.90 (1H, s), 4.90 (1H, br. m), 4.19 (2H, q, J 7.1Hz), 3.40-3.10 (2H, m), 3.01 (2H, m), 1.70 (2H, m), 1.25 (3H, t, J 7.2Hz), 1.02 (3H, t, J 7.5Hz): m/z (EI⁺, 70V) 565.

EXAMPLE 95

Ethyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl]-2-(5-methoxycarbonyl-4-propylthiopyridine-2-amino) propionate

The title compound was prepared by a similar procedure to the compound of Example 79, starting from ethyl 2-amino-4-propylthio-pyridine-5-carboxylate: δ H (CDCl₃) 8.65 (1H, s), 8.53 (2H, s), 8.05 (1H, br. s), 7.52 (2H, d, J 8.5Hz), 7.20 (2H, d, J 8.5Hz), 6.20 (1H, s), 5.62 (1H, br. m), 4.92 (1H, br. m), 4.20 (2H, q, J 7.2Hz), 3.90 (3H, s), 3.40-3.10 (2H, m), 2.72 (2H, t, J 7.4Hz), 1.72 (2H, m), 1.22 (3H, t, J 7.2Hz), 1.10 (3H, t, J 7.4Hz).

EXAMPLE 96

Ethyl 3-[4-(3,5-dichloropyrid-4-ylcarboxamido)phenyl]-2-(5-methoxycarbonyl-4-propylsulphonylpyridine-2-amino) propionate

The title compound was prepared by oxone oxidation of the compound of Example 95: isolated crude and used without further purification in Example 112.

EXAMPLE 97

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(3-benzyloxybenzeneamino) propanoic acid

The title compound was prepared by lithium hydroxide hydrolysis of the compound of Example 79: δ H (DMSO d₆) 10.84 (1H, s), 8.77 (2H, s), 7.53 (2H, d, J 8.6Hz), 7.42-7.26 (7H, m), 6.92 (1H, t, J 8.0Hz), 6.17 (3H, m), 4.97 (2H, s), 4.05 (1H, br. m), 3.29-2.89 (2H, m): m/z (EI⁺, 70V) 536.

EXAMPLE 98

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(3-benzyloxybenzeneamino) propanoic acid

The title compound was prepared by lithium hydroxide hydrolysis of the compound of Example 80: δ H (DMSO d_6) 10.83 (1H, s), 8.77 (2H, s), 7.53 (2H, d, J 8.5Hz), 7.27 (2H, d, J 8.5Hz), 6.95 (1H, t, J 7.9Hz), 6.52-6.30 (3H, m), 4.10 (1H, br. m), 3.20-2.90 (2H, m), 2.80 (2H, t, J 7.2Hz), 1.52 (2H, m), 0.92 (3H, t, J 7.4Hz): m/z (EI⁺, 70V) 504.

EXAMPLE 99

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(4-carboxybenzeneamino) propanoic acid

The title compound was prepared by lithium hydroxide hydrolysis of the compound of Example 81: δ H (DMSO d_6) 10.83 (1H, s), 8.77 (2H, s), 7.65 (2H, d, J 8.7Hz), 7.53 (2H, d, J 8.5Hz), 7.27 (2H, d, J 8.5Hz), 6.76 (1H, d, J 8.6Hz), 6.60 (2H, d, J 8.7Hz), 4.22 (1H, br. m), 3.30-2.95 (2H, m): m/z (EI⁺, 70V) 574.

EXAMPLE 100

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(3-propylsulphonylbenzeneamino) propanoic acid

The title compound was prepared by lithium hydroxide hydrolysis of the compound of Example 82: δ H (DMSO d_6) 10.84 (1H, s), 8.77 (1H, s), 7.53 (2H, d, J 8.5Hz), 7.29 (3H, m), 7.28 (1H, s), 7.01 (1H, d, J 7.6Hz), 6.86 (1H, d, J 8.1Hz), 6.55 (1H, d, J 8.9Hz), 4.20 (1H, br. m), 3.17-3.11 (3H, m), 2.91 (1H, dd, J 13.8, 8.7Hz), 1.48 (2H, m), 0.86 (3H, t, J 7.5Hz): m/z (EI⁺, 70V) 536.

EXAMPLE 101

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(3-propylsulphanylbenzeneamino) propanoic acid

The title compound was prepared by lithium hydroxide hydrolysis of the compound of Example 83: δ H (DMSO d_6) 12.75 (1H, br. s), 10.89 (1H, s), 8.80 (2H, s), 7.55 (2H, d, J 8.5Hz), 7.31 (2H, d, J 8.5Hz), 7.21 (1H, t, J 7.9Hz), 6.84 (1H, s), 6.76-6.68 (2H, m), 6.42 (1H, br. m), 3.33 (2H, t, J 8.9Hz), 3.30-2.50 (4H, m), 1.80-1.30 (2H, m), 0.93 (3H, t, J 7.2Hz): m/z (EI⁺, 70V) 520.

EXAMPLE 102

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(4-carboxymethylbenzeneamino) propanoic acid

The title compound was prepared by lithium hydroxide hydrolysis of the compound of Example 84: δ H (DMSO d_6) 10.83 (1H, s), 8.76 (2H, s), 7.53 (2H, d, J 8.5Hz), 7.27 (2H, d, J 8.5Hz), 6.92 (2H, d, J 8.5Hz), 6.51 (2H, d, J 8.5Hz), 4.00 (1H, br. m), 2.95 (2 H, m): m/z (EI⁺, 70V) 488.

EXAMPLE 103

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(3-acetylbenzeneamino) propanoic acid

The title compound was prepared by lithium hydroxide hydrolysis of the compound of Example 85: δ H (DMSO d_6) 10.84 (1H, s), 8.77 (2H, s), 7.53 (2H, d, J 8.5Hz), 7.29 (2H, d, J 8.5Hz), 7.30-7.10 (3H, m), 6.82 (1H, m), 6.20 (1H, br. m), 4.17 (1H, br. m), 3.20-2.90 (2H, m): m/z (EI⁺, 70V) 472.

EXAMPLE 104

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(2-chloro-pyridine-3-amino) propanoic acid

The title compound was prepared by lithium hydroxide hydrolysis of the compound of Example 86: δ H (DMSO d_6) 10.85 (1H, s), 8.77 (2H, s), 7.75-7.50 (3H, m), 7.40-7.10 (4H, m), 5.28 (1H, d, J 8.4Hz), 4.40 (1H, br. m), 3.15 (2H, d, J 5.9Hz): m/z (EI⁺, 70V) 467.

EXAMPLE 105

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(3-benzoylbenzeneamino) propanoic acid

The title compound was prepared by lithium hydroxide hydrolysis of the compound of Example 87: δ H (DMSO d_6) 10.84 (1H, s), 8.77 (2H, s), 7.90-7.40 (6H, m), 7.35-7.10 (3H, m), 7.05-6.80 (3H, m), 6.30 (1H, m), 4.14 (1H, br. m), 3.20-2.80 (2H, m): m/z (EI⁺, 70V) 534.

EXAMPLE 106

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(3-carboxybenzeneamino) propanoic acid

The title compound was prepared by lithium hydroxide hydrolysis of the compound of Example 88: δ H (DMSO d_6) 12.61 (1H, br. s), 10.84 (1H, s), 8.77 (2H, s), 7.54 (2H, d, J 8.5Hz), 7.30 (2H, d, J 8.5Hz), 7.13 (3H, m), 6.78 (1H, m), 6.20 (1H, br. m), 4.12 (1H, br. m), 3.20-2.90 (2H, m): m/z (EI⁺, 70V) 474.

EXAMPLE 107**3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(5-chloro-4-propylthiopyridine-2-amino) propanoic acid**

The title compound was prepared by lithium hydroxide hydrolysis of the compound of Example 89: δ H (DMSO d_6) 10.83 (1H, s), 8.77 (2H, s), 7.81 (1H, s), 7.53 (2H, d, J 8.4Hz), 7.23 (2H, d, J 8.4Hz), 6.54 (1H, s), 4.56 (1H, m), 3.20-2.80 (4H, m), 1.63 (2H, m), 0.99 (3H, t, J 7.3Hz): m/z (EI⁺, 70V) 540.

EXAMPLE 108**3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(5-chloro-4-propylsulphonylpyridine-2-amino) propanoic acid**

The title compound was prepared by lithium hydroxide hydrolysis of the compound of Example 90: δ H (DMSO d_6) 12.48 (1H, br. s), 10.72 (1H, s), 8.65 (1H, s), 7.86 (1H, s), 7.70-7.40 (3H, m), 7.20 (2H, m), 6.88 (1H, m), 4.40 (1H, br. m), 3.10-2.90 (2H, m), 2.90-2.50 (2H, m), 1.80-1.30 (2H, m), 0.85 (3H, m): m/z (EI⁺, 70V) 555.

EXAMPLE 109**3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(5-chloro-4-propylsulphonylpyridine-2-amino) propanoic acid**

The title compound was prepared by lithium hydroxide hydrolysis of the compound of Example 91: δ H (DMSO d_6) 10.84 (1H, s), 8.77 (2H, s), 8.18 (1H, s), 7.80 (1H, br. m), 7.53 (2H, d, J 8.5Hz), 7.26 (3H, m), 4.60 (1H, m), 3.41 (2H, m), 3.30-3.10 (1H, m), 3.10-2.80 (1H, m), 1.50 (2 H, m), 0.91 (3H, t, J 7.5Hz): m/z (EI⁺, 70V) 571.

EXAMPLE 110

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(5-chloropyridine-2-amino)propanoic acid

The title compound was prepared by lithium hydroxide hydrolysis of the compound of Example 92: δ H (DMSO d_6) 12.40 (1H, br. s), 10.71 (1H, s), 8.68 (2H, s), 7.79 (1H, s), 7.40 (2H, d, J 8.4Hz), 7.28 (1H, m), 7.12 (2H, d, J 8.4Hz), 6.91 (1H, d, J 8.2Hz), 6.47 (1H, d, J 8.9Hz), 4.45 (1H, m), 2.95 (1H, m), 2.77 (1H, m): m/z (EI⁺, 70V) 465.

EXAMPLE 111

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(4-propylsulphonylpyridine-2-amino) propanoic acid

The title compound was prepared by lithium hydroxide hydrolysis of the compound of Example 94: δ H (DMSO d_6) 10.86 (1H, s), 8.78 (2H, s), 8.19 (1H, d, J 5.3Hz), 7.55 (3H, m) 7.28 (2H, d, J 8.5Hz), 7.07 (1H, s), 6.88 (1H, m), 4.64 (1H, br. m), 3.27 (2H, t, J 7.7Hz), 3.12 (1H, m), 2.92 (1H, m), 1.50 (2H, m), 0.91 (3H, t, J 7.4Hz): m/z (EI⁺, 70V) 537.

EXAMPLE 112

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(5-carboxy-4-propylsulphonylpyridine-2-amino)propanoic acid

The title compound was prepared by lithium hydroxide hydrolysis of the compound of Example 96: δ H (DMSO d_6) 13.0 (1H, br. s), 10.85 (1H, s), 8.78 (2H, s), 8.48 (1H, s), 7.55 (2H, d, J 8.6Hz), 7.26 (3 H, m), 4.70 (1H, br. n), 3.66 (2H, t, J 7.7Hz), 3.40-2.90 (2H, m), 1.58 (2H, m), 0.94 (3H, t, J 7.4Hz): m/z (EI⁺, 70V) 581.

EXAMPLE 113

S-3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(5-carboxy-4-trifluormethylpyrimidin-2-ylamino)propanoic acid

The title compound was prepared from Intermediate 3 and methyl 2-chloro-4-(trifluoromethyl)pyrimidine 5-carboxylate, followed by hydrolysis: δ H (DMSO d_6) 10.80 (1H, br s), 8.77 (1H, s), 8.75 (2H, s), 8.51 and 8.38 (together 1H, d, J 8.0Hz), 7.53 (2H, d, J 8.0Hz), 7.32 (2H, d, J 8.0Hz), 4.65-4.50 (1H, br m), 3.21 (1H, dd, J 13.9, 3.9 Hz) and 3.03 (1H, dd, J 13.9, 10.4Hz); m/z (El^+ , 60V) 545.

EXAMPLE 114

S-ethyl-3-[4-(3,5-dichloro-1-oxido-4-pyridiniocarboxamido)phenyl]-2-(6-propylsulphonylpyrimidin-4-yl)propanoate and S-ethyl-3-[4-(3,5-dichloro-1-oxido-4-pyridiniocarboxamidophenyl)-2-(6-propylsulphonyl-1-oxido-4-pyrimidinio) propanoate

A solution of the compound of Example 6 (14.0g, 25.2mmol) and mCPBA 30g, 105mmol assuming 60% pure) in dichloromethane (300ml) were stirred at room temperature for 8H. The mixture was then treated with 10% aqueous sodium sulfite solution (200ml) and stirred for 5mins. A further 200ml of DCM was added before washing consecutively with saturated aqueous $NaHCO_3$ (200ml), brine (200ml) and water (200ml) dried ($MgSO_4$) and evaporated in vacua. The yellow solid obtained was chromatographed (silica; ethyl acetate→ethyl acetate/methanol (10%)) to afford

S-ethyl-3-[4-(3,5-dichloro-1-oxido-4-pyridiniocarboxamido)phenyl]-2-(6-propylsulphonylpyrimidin-4-yl)propanoate (3.0g) and S-ethyl-3-[4-(3,5-dichloro-1-oxido-4-pyridiniocarboxamidophenyl)-2-(6-propylsulphonyl-1-oxido-4-pyrimidinio)propanoate (5.5g).

These materials were used without further characterisation in Examples 115 and 116.

EXAMPLE 115

S-3-[4-(3,5-Dichloro-1-oxido-4-pyridiniocarboxamido)phenyl]-2-(6-propylsulphonylpyrimidin-4-ylamino)propanoic acid

A solution of the mono-N-oxide from Example 114 (3.0g, 5.2mmol) and lithium hydroxide monohydrate (0.32g, 7.74mmol) in THF/H₂O (1:1, 100ml) was stirred overnight at room temperature. THF was removed by evaporation *in vacuo*, and water (100ml) added. The reaction mixture was made pH3 with hydrochloric acid (1M) and then filtered and precipitate collected and dried. Purification by recrystallisation (acetonitrile/H₂O) gave the title compound as a white powder (500mg, 17%). δ H (DMSO *d*₆) 10.83 (1H, s), 8.72 (2H, s), 8.57 (1H, s), 8.45 (1H, d, *J* 7.7Hz), 7.55 (2H, d, *J* 8.5Hz), 7.27 (2H, d, *J* 8.5Hz), 7.22 (1H, s), 4.78 (1H, dt, *J* 8.6, 5.0Hz), 3.2 (m, obscured by H₂O), 3.00 (2H, dd, *J* 13.9, 9.11Hz), 1.59 (2H, q, *J* 7.6Hz), 0.94 (3H, t, *J* 7.4Hz); m/z (EI⁺, 80V) 554.

EXAMPLE 116

S-3-[4-(3,5-Dichloro-1-oxido-4-pyridiniocarboxamido)phenyl]-2-(6-propylsulphonyl-1-oxido-4-pyrimidinioamino)propanoic acid

A solution of the di-N-oxide from Example 114 (5.5g, 9.2mmol) and lithium hydroxide monohydrate (0.6g, 13.8mmol) in THF/H₂O 1:1 (100ml) was stirred overnight at room temperature. The THF was then removed *in vacuo* and the remaining solution diluted with H₂O (100ml), before 1M HCl added to make the pH3. The precipitate was collected by filtration, dried to give the title compound as a pale yellow solid (40g, 76%). δ H (DMSO *d*₆) 10.83 (1H, s), 8.72 (2H, s), 8.57 (1H, s), 8.45 (1H, d, *J* 7.7Hz), 7.55 (2H, d, *J* 8.5Hz), 7.27 (2H, d,

1 8.5Hz), 7.22 (1H, s), 4.78 (1H, m), 3.2 (m, obscured by H₂O), 1.60 (2H, q, J 7.6Hz), 0.93 (3H, t, J 7.4Hz); m/z (EI⁺, 80V) 572.

EXAMPLE 117

5 **3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(6-propylpyrid-2-ylamino)propanoic acid**

A mixture of Intermediate 25 (150mg), dirhodiumtetraacetate, (1.8mg, 5.1 μ mols) and 2-amino-6-propylpyridine in anhydrous toluene (2.5mL) was agitated at ambient temperature for 0.5h then at 80°C for 6h. The resin was filtered and
10 then washed with DCM, DMF, methanol, water, methanol, DMF and DCM. The resin was treated with 50% trifluoroacetic acid in DCM (4.0ml) for 3h with agitation and filtered. The resin was then washed with a 4.0ml portion of DCM. The combined filtrate was evaporated *in vacuo* to give the crude product (48mg) which was purified by preparative HPLC to afford the title compound (2.7mg).
15 HPLC-MS Retention time 2.19min; MH⁺ 473.

HPLC-MS

HPLC-MS was performed on a Hewlett Packard 1100/MSD ES Single Quadropole system with diode array detector using a Luna C18(2) 50 x 2.0mm
20 (3 μ m) column, running a gradient of 95% [0.1% aqueous formic acid], 5% [0.1% formic acid in acetonitrile] to 10% [0.1% aqueous formic acid], 90% [0.1% formic acid in acetonitrile] over 2min, then maintaining the mobile phase at that ratio for a further 1 min. Flow rate 0.8ml/min. MS was acquired by API electrospray in positive ion mode, at 70V, scanning from 150 to 750amu.

25 The following compounds of Examples 118 - 168 were prepared in a similar manner to the compound of Example 117, each using the starting material shown in place of 2-amino-6-propylpyridine.

EXAMPLE 118

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(3-methylisoxazol-5-ylamino)propanoic acid

5-Amino-3-methylisoxazole gave the title compound (0.7mg) HPLC-MS
Retention time 2.37min; MH^+ 435.

EXAMPLE 119

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-[2-acetyl-5-(4-chlorophenyl)thien-3-ylamino]propanoic acid

2-Acetyl-3-amino-5-(4-chlorophenyl)thiophene gave the title compound
(2.6mg) HPLC-MS Retention time 2.90min; MH^+ 588.

EXAMPLE 120

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(2-methylquinol-6-ylamino)propanoic acid

6-Amino-2-methylquinoline gave the title compound (5.0mg) HPLC-MS
Retention time 2.17min; MH^+ 495.

EXAMPLE 121

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(quinol-6-ylamino)propanoic acid

6-Aminoquinoline gave the title compound (3.3mg) HPLC-MS Retention
time 2.15min; MH^+ 481

EXAMPLE 122

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(quinol-2-ylamino)propanoic acid

2-Aminoquinoline gave the title compound (4.3mg) HPLC-MS Retention time 2.20min; MH^+ 481.

EXAMPLE 123

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(quinol-3-ylamino)propanoic acid

3-Aminoquinoline gave the title compound (5.1 mg) HPLC-MS Retention time 2.22min; MH^+ 481.

EXAMPLE 124

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-[4-chloro-2-(methylthio)pyrimidin-6-yl amino]propanoic acid

6-Amino-4-chloro-2-(methylthio)pyrimidine gave the title compound (1.4mg) HPLC-MS Retention time 2.63min; MH^+ 512.

EXAMPLE 125

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(3,5-dichloro-2,6-difluoropyrid-4-ylamino)propanoic acid

4-Amino-3,5-dichloro-2,6-difluoropyridine gave the title compound (1.1 mg) HPLC-MS Retention time 2.81 min; MH^+ 535.

EXAMPLE 126

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(4,6-dimethylpyrid-2-ylamino)propanoic acid

2-Amino-4, 6-dimethylpyridine gave the title compound (3.9mg)
HPLC-MS Retention time 2.11 min; MH⁺ 459,

EXAMPLE 127

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(4,6-dimethoxypyrimidin-2-ylamino)propanoic acid

2-Amino-4, 6-dimethoxypyrimidine gave the title compound (3.0mg)
HPLC-MS Retention time 2.56min; MH⁺ 492.

EXAMPLE 128

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(2-methylpyrid-4-ylamino)propanoic acid

4-Amino-2-methylpyridine gave the title compound (1.3mg) HPLC-MS
Retention time 2.09min; MH⁺ 445.

EXAMPLE 129

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(6-chloropyrid-3-ylamino)propanoic acid

3-Amino-6-chloropyridine gave the title compound (2.7mg) HPLC-MS
Retention time 2.52min; MH⁺ 465.

EXAMPLE 130

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(5-bromopyrid-2-ylamino)propanoic acid

2 Amino-5-bromo-2-pyridine gave the title compound (2.6mg) HPLC-MS
Retention time 2.60min; MH^+ 510.

EXAMPLE 131

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(2,6-dichloropyrid-4-ylamino)propanoic acid

4-Amino-2, 6-dichloropyridine gave the title compound (1.6mg)
HPLC-MS Retention time 2.62min; MH^+ 499

EXAMPLE 132

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(3,5-dibromopyrid-2-ylamino)propanoic acid

2-Amino-3, 5-dibromopyridine gave the title compound (0.2mg)
HPLC-MS Retention time 2.83min; MH^+ 589.

EXAMPLE 133

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(4,6-dimethylpyrimidin-2-ylamino)propanoic acid

2-Amino-4, 6-dimethylpyrimidine gave the title compound (2.7mg)
HPLC-MS Retention time 2.23min; MH^+ 460.

EXAMPLE 134

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(3-ethyl-6-methylpyrid-2-ylamino)propanoic acid

2-Amino-3-ethyl-6-methylpyridine gave the title compound (1.3mg)
HPLC-MS Retention time 2.23min; MH⁺ 473.

EXAMPLE 135

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(4-ethylpyrid-2-ylamino)propanoic acid

2-Amino-4-ethylpyridine gave the title compound (0.8mg) HPLC-MS
Retention time 2.14min; MH⁺ 459.

EXAMPLE 136

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(6-ethylpyrid-2-ylamino)propanoic acid

2-Amino-6-ethylpyridine gave the title compound (2.4mg) HPLC-MS
Retention time 2.14min; MH⁺ 459.

EXAMPLE 137

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(2,5-dichloropyrid-3-ylamino) propanoic acid

3-Amino-2, 5-dichloropyridine gave the title compound (1.0mg)
HPLC-MS Retention time 2.68min; MH⁺ 501.

EXAMPLE 138

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(4-trifluoromethylpyrimidin-2-ylamino) propanoic acid

2-Amino-4-trifluoromethylpyrimidine gave the title compound (1.2mg)
HPLC-MS Retention time 2.62min; MH⁺ 500.

EXAMPLE 139

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(5-bromopyrimidin-2-ylamino)propanoic acid

2-Amino-5-bromopyrimidine gave the title compound (0.6mg) HPLC-MS
Retention time 2.56min; MH⁺ 511.

EXAMPLE 140

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(2-chloropyrid-3-ylamino)propanoic acid

3-Amino-2-chloropyridine gave the title compound (2.5mg) HPLC-MS
Retention time 2.52min; MH⁺ 465.

EXAMPLE 141

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-[4-trifluoromethyl-6-methylpyrimidin-2-ylamino)propanoic acid

2-Amino-4-trifluoromethyl-6-methylpyrimidine gave the title compound
(3.1mg) HPLC-MS Retention time 2.65min; MH⁺ 514.

EXAMPLE 142**3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(4,6-dichloro-2-methylpyrimidin-5-ylamino) propanoic acid**

5 Amino-4, 6-dichloro-2-methylpyrimidine gave the title compound (1.7mg) HPLC-MS Retention time 2.55min; M_r^+ 516.

EXAMPLE 143**3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(4,6-dimethoxypyrimidin-5-ylamino) propanoic acid**

5-Amino-4, 6-Dimethoxypyrimidine gave the title compound (0.9mg) HPLC-MS Retention time 2.43min; MH^+ 492.

EXAMPLE 144**3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(3-benzyloxypyrid-2-ylamino) propanoic acid**

2-Amino-3-benzyloxypyridine gave the title compound (2.8mg) HPLC-MS Retention time 2.33min; MH^+ 537.

EXAMPLE 145**3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-[4-(5-chloropyrid-2-yloxy)phenylamino] propanoic acid**

4-(5-Chloropyrid-2-yloxy)aniline gave the title compound (1.7mg) HPLC-MS Retention time 2.73min; MH^+ 557.

EXAMPLE 146

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(2-chloro-5-phenylpyrid-6-ylamino) propanoic acid

6-Amino-2-chloro-5-phenylpyridine gave the title compound (0.5mg)
HPLC-MS Retention time 2.87min MH⁺ 541

EXAMPLE 147

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(1-oxidopyrid-3-ylamino)propanoic acid

3-Aminopyridine-1-oxide gave the title compound (1.1mg) HPLC-MS
Retention time 2.16min; MH⁺ 447.

EXAMPLE 148

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-[4-(4-methylphenyl)pyrimidin-2-ylamino] propanoic acid

2-Amino-4-(4-methylphenyl)pyrimidine gave the title compound (2.2mg)
HPLC-MS Retention time 2.57min; MH⁺ 522.

EXAMPLE 149

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-[4-(4-chlorophenyl)pyrimidin-2-ylamino] propanoic acid

2-Amino-4-(4-chlorophenyl)pyrimidine gave the title compound (0.8mg)
HPLC-MS Retention time 2.67min; MH⁺ 542.

EXAMPLE 150

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(4-chloro-6-pyrrolidinopyrimidin-2-ylamino) propanoic acid

2-Amino-4-chloro-6-pyrrolidinopyrimidine gave the title compound
(3.2mg) HPLC-MS Retention time 2.59min; MH⁺ 537.

EXAMPLE 151

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(4-(chlorodifluoromethyl)-6-methyl pyrimidin-2-ylamino)propanoic acid

2-Amino-4-(chlorodifluoromethyl)-6-methylpyrimidine gave the title compound (0.6mg) HPLC-MS Retention time 2.66min; MH⁺ 532.

EXAMPLE 152

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(3,5-difluorophenylamino)propanoic acid

3,5-Difluoroaniline gave the title compound (1 mg) HPLC-MS Retention 2.67 min; MH⁺ 466.

EXAMPLE 153

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(2,4,6-trimethylphenylamino)propanoic acid

2,4,6-Trimethylaniline gave the title compound (4 mg) HPLC-MS Retention 2.77 min; MH⁺ 472.

EXAMPLE 154

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(2,6-diethylphenylamino)propanoic acid

2,6-Diethylaniline gave the title compound (6 mg) HPLC-MS Retention
2.85 min; MH^+ 486

EXAMPLE 155

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(3-(trifluoromethyl)phenylamino)propanoic acid

3-(Trifluoromethyl)aniline gave the title compound (3 mg) HPLC-MS
Retention 2.74 min; MH^+ 498.

EXAMPLE 156

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(2-propylphenylamino)propanoic acid

2-Propylaniline gave the title compound (2 mg) HPLC-MS Retention 2.80
min; MH^+ 472.

EXAMPLE 157

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(4-ethylphenylamino)propanoic acid

4-Ethylaniline gave the title compound (2 mg) HPLC-MS Retention 2.72
min; MH^+ 458.

EXAMPLE 158

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(3,4,5-trichlorophenylamino)propanoic acid

3,4,5-Trichloroaniline gave the title compound (1 mg) HPLC-MS Retention
2.86 min; MH^+ 532.

EXAMPLE 159

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(3,4,5-trifluorophenylamino)propanoic acid

3,4,5-Trifluoroaniline gave the title compound (3 mg) HPLC-MS Retention
2.70 min; MH^+ 484

EXAMPLE 160

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(2-benzylphenylamino)propanoic acid

2-Benzylaniline gave the title compound (1 mg) HPLC-MS Retention 2.84
min; MH^+ 520

EXAMPLE 161

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(3,5-bis(trifluoromethyl)phenylamino)propanoic acid

3,5-Bis(trifluoromethyl)aniline gave the title compound (1 mg) HPLC-MS
Retention 2.87 min; MH^+ 566.

EXAMPLE 162

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(4-isopropylphenylamino)propanoic acid

4-Isopropylaniline gave the title compound (2 mg) HPLC=MS Retention
2.80 min; MH^+ 472.

EXAMPLE 163

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(3-trifluoromethoxyphenylamino)propanoic acid

3-Trifluoromethoxyaniline gave the title compound (4 mg) HPLC-MS
Retention 2.76 min; MH^+ 514.

EXAMPLE 164

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(2-fluoro-5-(trifluoromethyl)phenylamino)propanoic acid

2-Fluoro-5-(trifluoromethyl)aniline gave the title compound (4 mg)
HPLC-MS Retention 2.75 min; MH^+ 516.

EXAMPLE 165

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(3-chloro-4-fluorophenylamino)propanoic acid

3-Chloro-4-fluoroaniline gave the title compound (6 mg) HPLC-MS
Retention 2.70 min; MH^+ 482.

EXAMPLE 166

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(3-nitrophenylamino)propanoic acid

3-Nitroaniline gave the title compound (2 mg) HPLC-MS 2.62 min; MH⁺ 475.

EXAMPLE 167

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(2,3,5,6-tetrafluorophenylamino)propanoic acid

2,3,5,6-tetrafluoroaniline gave the title compound (1 mg) HPLC-MS Retention 2.72 min; MH⁺ 502.

EXAMPLE 168

3-[4-(3,5-Dichloropyrid-4-ylcarboxamido)phenyl]-2-(3-chlorophenylamino)propanoic acid

3-Chloroaniline gave the title compound (1 mg) HPLC-MS Retention 2.70 min; MH⁺ 464.

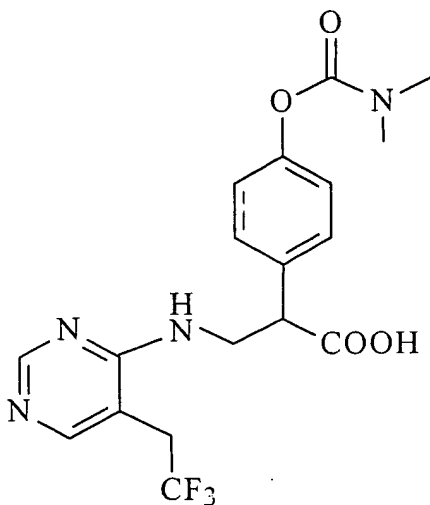
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The following compound of this invention was prepared as follows:

Example 169

Synthesis of

N-[3-(5-(2,2,2-trifluoroethyl)pyrimidin-4-yl)amino]-2-(4-(*N,N'*-
dimethylaminocarbonyloxy)phenyl)propionic acid



3-Amino-2(R)-(4-hydroxyphenyl)propionic acid is prepared as per the
procedure of Arvanitis, et al., J. Chem. Soc., Perkin Trans., 1(8):1459 (1998).
This compound is converted via conventional methods to provide for ethyl N-Boc
3-amino-2(R)-(4-hydroxyphenyl)propionic acid. This compound is converted by
method A below to provide for ethyl N-Boc 2(R)-(4-N,N-dimethylamino-
carbonyloxyphenyl)propionate. Conventional deprotection provides for ethyl
2(R)-(4-N,N-dimethylamino-carbonyloxyphenyl)propionate.

2,2,2-Trifluoroethyl (prepared accordingly to Gassman, et al. J. Org.
Chem., 1984, 49(12), 2258-2273) is converted via sequential application of
methods B, C, and D (as below) to give 4,6-dichloro-5-(2,2,2-
trifluoroethyl)pyrimidine.

Ethyl 2(R)-(4-N,N-dimethylaminocarbonyloxyphenyl)propionate and 4,6-dichloro-5-(2,2,2-trifluoroethyl)pyrimidine were coupled via method E and the product was transformed via sequential application of methods F and G to give the title compound.

5

Method A

Carbamate Formation Procedure I

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Into a reaction vial are combined 15.2 mmol, 1.0 eq. of the starting hydroxy compound and 1.86 g (15.2 mmol, 1.0 eq) DMAP. Methylene chloride (50 mL), triethylamine (2.12 mL, 1.54 g, 15.2 mmol, 1.0 eq), and dimethylcarbonyl chloride (1.68 mL, 1.96 g, 18.2 mmol, 1.2 eq) are then added. The vial is capped tightly, and the reaction solution is swirled to obtain a homogeneous solution. The reaction solution is then heated to 40°C. After 48 h, TLC of the resulting colorless solution indicates complete conversion. The work-up of the reaction solution is as follows: 50 mL EtOAc and 50 mL hexanes is added to the reaction mixture, and the resulting mixture is washed with 0.5 M citric acid (3 x 50 mL), water (2 x 50 mL), 10% K₂CO₃ (2 x 50 mL), and sat. NaCl (1 x 50 mL); dried with MgSO₄, filtered and evaporated to afford the desired compound.

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Method B

Preparation of Dimethyl 2-Alkylmalonate

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To a suspension of sodium hydride 60% dispersion in mineral oil (1.1 eq) in anhydrous THF is added slowly with stirring dimethyl malonate (1.1 eq), causing the evolution of gas. To the resulting solution is added a bromoalkane, iodoalkane, or trifluoromethanesulfonyloxyalkane (1.0 eq), and the mixture is heated to 50°C for 48 h, at which point TLC indicated consumption of the bromoalkane, iodoalkane, or trifluoromethanesulfonyl-oxyalkane. The mixture is

diluted with diethyl ether and washed with 70% saturated sodium chloride. The organic extracts are treated with anhydrous magnesium sulfate, filtered, and evaporated to afford a dimethyl 2-alkylmalonate of sufficient purity for immediate conversion to a 5-alkyl-4,6-dihydroxypyrimidine.

5

Method C

Preparation of 5-Alkyl-4,6-dihydroxypyrimidine

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To a diethyl 2-alkylmalonate or a dimethyl 2-alkylmalonate (1.0 eq) is added formamidine acetate (1.0 eq) and 25% sodium methoxide in methanol (3.3 eq). The resulting slurry is stirred vigorously and heated to 60°C for 4 h, and then allowed to cool. The slurry is diluted with water, and acidified to pH = 2 by addition of HCl. The resulting precipitate is collected by filtration, is washed with water, and is dried under vacuum, to afford a 5-alkyl-4,6-dihydroxypyrimidine of sufficient purity for immediate conversion to a 5-alkyl-4,6-dichloropyrimidine.

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Method D

Preparation of

5-Alkyl-4,6-dichloropyrimidine or 5-Alkoxy-4-chloropyrimidine

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To a 5-alkyl-4,6-dihydroxypyrimidine or a 5-alkoxy-4-hydroxypyrimidine (1.0 eq) are added phosphorus oxychloride (15.0 eq) and *N,N*-dimethylaniline (1.0 eq), and the mixture is heated to 100°C for 3 h, and then is allowed to cool. The resulting solution is poured onto ice, and the mixture is extracted with dichloromethane. The organic extracts are treated with anhydrous magnesium sulfate, filtered, and is evaporated to afford a 5-alkyl-4,6-dichloropyrimidine or a 5-alkoxy-4-chloropyrimidine of sufficient purity for immediate conversion to a 5-alkyl-4-*N*-alkylamino-6-chloropyrimidine or a 5-alkoxy-4-*N*-alkylaminopyrimidine.

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Method E

Preparation of

5-Alkyl-4-N-alkylamino-6-chloropyrimidine or

5-Alkoxy-4-N-alkylaminopyrimidine

5 To a solution of a 5-alkyl-4,6-dichloropyrimidine or a 5-alkoxy-4-chloropyrimidine (1.0 eq) in ethanol are added an alkyl amine (1.2 eq, typically L-4-(*N,N*-dimethylcarbamyloxy)-phenylalanine *tert*-butyl ester) and diisopropylethylamine (2.0 eq). The mixture is sealed in a pressure tube and is heated to 120°C for 48 h, at which point TLC indicates consumption of the 5-alkyl-4,6-dichloropyrimidine or the 5-alkoxy-4-chloropyrimidine. The mixture is evaporated, and the residue is partitioned between ethyl acetate and pH = 4.5 citrate buffer. The organic extracts are washed with saturated sodium chloride, treated with anhydrous magnesium sulfate, filtered, and evaporated. The residue is purified by chromatography on silica gel using ethyl acetate and hexanes to afford a pure 5-alkyl-4-*N*-alkylamino-6-chloropyrimidine or 5-alkoxy-4-*N*-alkylaminopyrimidine.

Method F

Preparation of 5-Alkyl-4-N-alkylaminopyrimidine (Procedure I)

20 A suspension of 5-alkyl-4-*N*-alkylamino-6-chloropyrimidine (1.0 eq), and an equal mass 10% palladium on carbon, and sodium bicarbonate (5.0 eq) in methanol is shaken under 55 psi hydrogen gas for 16 h, at which point TLC indicates consumption of the 5-alkyl-4-*N*-alkylamino-6-chloropyrimidine. The mixture is filtered through Celite and evaporated to give a residue, which is partitioned between ethyl acetate and 70% saturated sodium chloride. The organic extracts are treated with anhydrous magnesium sulfate, filtered, and evaporated. The residue is purified by chromatography on silica gel using ethyl acetate and hexanes to afford a pure 5-alkyl-4-*N*-alkylaminopyrimidine.

Method G

Ester Hydrolysis Procedure II

To a chilled (0°C) THF/H₂O solution (2:1, 5 - 10 mL) of the appropriate ester is added LiOH (1.1 equivalents). The temperature is maintained at 0°C and the reaction is complete in 1-3 hours. The reaction mixture is concentrated and the residue is taken up into H₂O and the pH is adjusted to 2-3 with aqueous HCl. The product is extracted with ethyl acetate and the combined organic phase is washed with brine, dried over MgSO₄, filtered and concentrated to yield the desired acid.

The following assays can be used to demonstrate the potency and selectivity of the compounds according to the invention. In each of these assays an IC₅₀ value was determined for each test compound and represents the concentration of compound necessary to achieve 50% inhibition of cell adhesion where 100% = adhesion assessed in the absence of the test compound and 0% = absorbance in wells that did not receive cells.

 $\alpha_4\beta_1$ Integrin-dependent Jurkat cell adhesion to VCAM-Ig

96 well NUNC plates were coated with F(ab)₂ fragment goat anti-human IgG Fc γ -specific antibody [Jackson Immuno Research 109-006-098: 100 μ l at 2 μ g/ml in 0.1M NaHCO₃, pH 8.4], overnight at 4°. The plates were washed (3x) in phosphate-buffered saline (PBS) and then blocked for 1h PBS/1% BSA at room temperature on a rocking platform. After washing (3x in PBS) 9 ng/ml of purified 2d VCAM-Ig diluted in PBS/1% BSA was added and the plates left for 60 minutes at room temperature on a rocking platform. The plates were washed (3x in PBS) and the assay then performed at 370 for 30 min in a total volume of 200 μ l containing 2.5 x 10⁵ Jurkat cells in the presence or absence of titrated test compounds.

Each plate was washed (2x) with medium and the adherent cells were fixed with 100 μ l methanol for 10 minutes followed by another wash. 100 μ l 0.25% Rose

Bengal (Sigma R4507) in PBS was added for 5 minutes at room temperature and the plates washed (3x) in PBS. 100 μ l 50% (v/v) ethanol in PBS was added and the plates left for 60min after which the absorbance (570nm) was measured.

5 $\alpha_4\beta_7$ Integrin-dependent JY cell adhesion to MAdCAM-Ig

This assay was performed in the same manner as the $\alpha_4\beta_1$ assay except that MAdCAM-Ig (150ng/ml) was used in place of 2d VCAM-Ig and a subline of the β -lympho blastoid cell-line JY was used in place of Jurkat cells. The IC₅₀ value for each test compound was determined as described in the $\alpha_4\beta_1$ integrin assay.

10 $\alpha_5\beta_1$ Integrin-dependent K562 cell adhesion to fibronectin

96 well tissue culture plates were coated with human plasma fibronectin (Sigma F0895) at 5 μ g/ml in phosphate-buffered saline (PBS) for 2 hr at 37°C. The plates were washed (3x in PBS) and then blocked for 1h in 100 μ l PBS/1% BSA at room temperature on a rocking platform. The blocked plates were washed (3x in PBS) and the assay then performed at 37°C in a total volume of 200 μ l containing 2.5x 10⁵ K562 cells, phorbol-12-myristate-13-acetate at 10ng/ml, and in the presence or absence of titrated test compounds. Incubation time was 30 minutes. Each plate was fixed and stained as described in the $\alpha_4\beta_1$ assay above.

20 $\alpha_m\beta_2$ -dependent human polymorphonuclear neutrophils adhesion to plastic

96 well tissue culture plates were coated with RPMI 1640/10% FCS for 2h at 37°C. 2 x 10⁵ freshly isolated human venous polymorphonuclear neutrophils (PMN) were added to the wells in a total volume of 200 μ l in the presence of 10ng/ml phorbol-12-myristate-13-acetate, and in the presence or absence of test compounds, and incubated for 20min at 37°C followed by 30min at room temperature. The plates were washed in medium and 100 μ l 0.1% (w/v) HMB (hexadecyl trimethyl ammonium bromide, Sigma H5882) in 0.05M potassium

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phosphate buffer, pH 6.0 added to each well. The plates were then left on a rocker at room temperature for 60 min. Endogenous peroxidase activity was then assessed using tetramethyl enzidine (TMB) as follows: PMN lysate samples mixed with 0.22% H₂O₂ (Sigma) and 50 µg/ml TMB (Boehringer Mannheim) in 0.1M sodium acetate/citrate buffer, pH 6.0 and absorbance measured at 630nm.

α11b/β₃-dependent human platelet aggregation

Human platelet aggregation was assessed using impedance aggregation on the Chronolog Whole Blood Lumiaggregometer. Human platelet-rich plasma (PRP) was obtained by spinning fresh human venous blood anticoagulated with 0.38% (v/v) tri-sodium citrate at 220xg for 10 min and diluted to a cell density of 6 x 10⁸/ml in autologous plasma. Cuvettes contained equal volumes of PRP and filtered Tyrode's buffer (g/liter: NaCl 8.0; MgCl₂.H₂O 0.427; CaCl₂ 0.2; KCl 0.2; D-glucose 1.0; NaHCO₃ 1.0; NaHPO₄.2H₂O 0.065). Aggregation was monitored following addition of 2.5 µM ADP (Sigma) in the presence or absence of inhibitors.

In the above assays the preferred compounds of the invention generally have IC₅₀ values in the α₄β₁ and α₄β₇ assays of 1 µM and below. In the other assays featuring α integrins of other subgroups the same compounds had IC₅₀ values of 50 µM and above thus demonstrating the potency and selectivity of their action against α₄ integrins.